This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

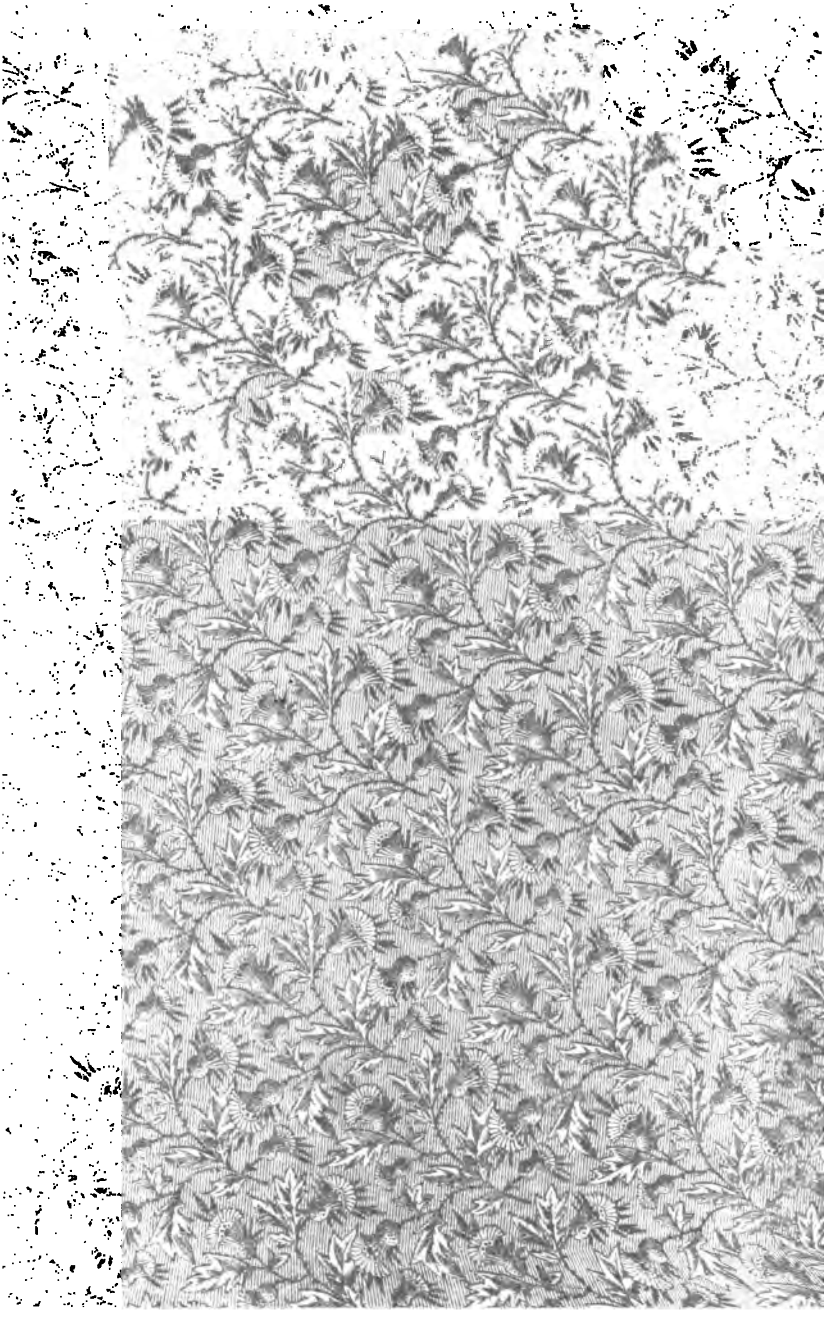
Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

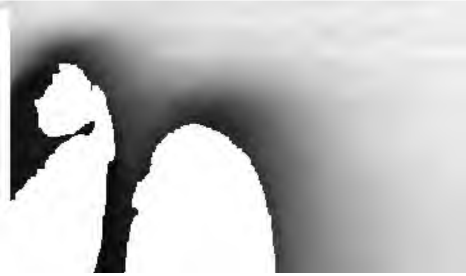
LANE

MEDICAL LIBRARY

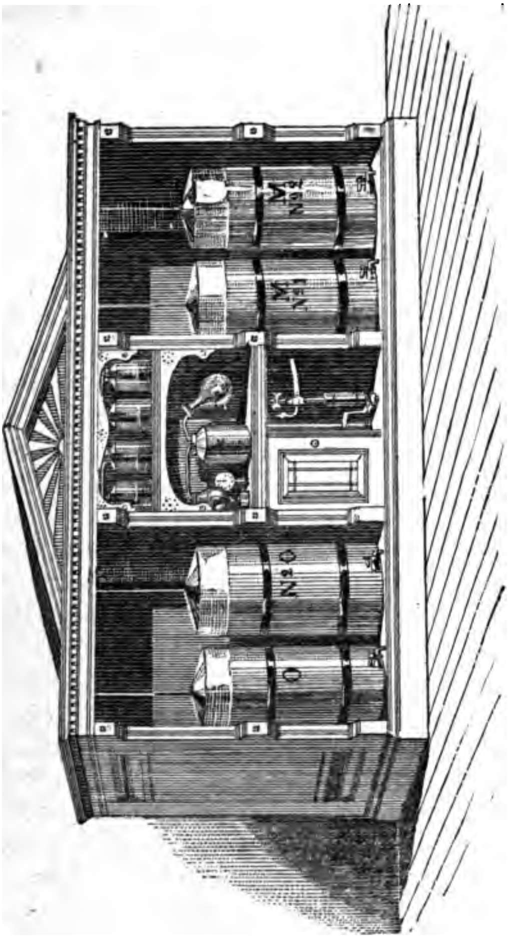
SEAL OF THE LELAND STANFORD JUNIOR UNIVERSITY
1885

LEVI COOPER LANE FUND





54a


M N° 2
M N° 1
N° 2 O
O

OXYGEN

IN

THERAPEUTICS.

LANE LIBRARY

A TREATISE EXPLAINING THE APPARATUS, THE MATERIAL AND
THE PROCESSES USED IN THE PREPARATION OF OXYGEN
AND OTHER GASES WITH WHICH IT MAY BE
COMBINED; ALSO, ITS ADMINISTRATION
AND EFFECTS, ILLUSTRATED BY
CLINICAL EXPERIENCE OF
THE AUTHOR AND
OTHERS.

LANE MEDICAL LIBRARY
12441
SAN FRANCISCO

BY

C. E. EHINGER, M.D.

CHICAGO:
W. A. CHATTERTON & CO.,
1887.

COPYRIGHT, 1887
BY
C. E. EHINGER.

W8 E3
1887

To my Wife,

ELLA M. EHINGER,

TO WHOSE VALUED ASSISTANCE IN THIS, AS IN ALL MY
UNDERTAKINGS, I OWE SO MUCH, THIS VOLUME
IS AFFECTIONATELY INSCRIBED BY

THE AUTHOR.

PREFACE.

In December, 1885, the author of this volume wrote an article entitled "Oxygen as a Therapeutic Agent," which was published in the January (1886) number of the "Medical Current," of Chicago. It elicited so many inquiries, and so much interest was manifested in the subject, that the editor of the "Current" invited the writer to contribute a series of articles for that journal, embodying the result of his experience with oxygen, and giving some information concerning the apparatus, material and processes employed in the preparation of oxygen and its congener, nitrogen monoxide. In compliance with this request the writer furnished a series of short articles which ran through some five or six numbers of that journal. The numbers containing these articles were soon exhausted, though the demand for them continued unabated.

At the solicitations of professional friends and other physicians interested in this subject, the writer finally decided to prepare a small volume on oxygen, and this little work is the outgrowth of that decision.

The articles originally published in the "Medical Current," with some changes and many additions, appear again here.

It is the aim of this work to supply an apparent demand for a hand-book on oxygen; it is intended to furnish information and practical details necessary for the construction and operation of the apparatus required to prepare and administer oxygen and nitrogen monoxide.

It seems scarcely necessary to add that it is in no wise intended to occupy the place of an exhaustive treatise upon this subject, but rather as a brief review of it.

The author makes no claim to originality, and has nothing essentially new to offer. In the preparation of the work he has gleaned from every reliable source at his command, always, however, endeavoring to give proper credit.

That portion of the book treating of the apparatus, chemicals, preparation and administration of the gases is the result of his own experience, and contains some suggestions which, so far as he knows, are new.

Dr. Andrew H. Smith's "Prize Essay on Oxygen in Disease," and Dr. Sam'l S. Wallian's articles in the New York "Medical Record," have been freely consulted and have rendered valuable assistance, as the many quotations from these eminent authorities will abundantly attest.

Many additional clinical cases from the author's practice might have been included, but he preferred to report only such as had discontinued the treatment long enough to determine something as to the permanency of the relief obtained.

The author desires particularly to acknowledge his indebtedness to Prof. Clifford Mitchell, of Chicago, for the valuable assistance rendered by him in reading and correcting the manuscript of Part I, and for his many useful suggestions.

If the matter herein contained be the means of interesting a few thoughtful and conscientious practitioners in the study of oxygen, and supply them with the required information for preparing and using it in their practice, thus assisting in the further introduction of this valuable agent, this little volume will have accomplished its purpose.

QUINCY, Ill., C. E. EHINGER.
January, 1887.

PART I.

METHODS OF PREPARING OXYGEN AND NITROGEN MONOXIDE.—APPARATUS FOR GENERATING, STORING AND COMMINGLING THE GASES, ETC.

Properties, Uses and Distribution of Oxygen.

[Symbol, O; Quantivalence, 2; Atomic weight, 16.]

Oxygen was discovered in 1774 by Dr. Joseph Priestley, of England. It is the most important and abundant of the elements and is often spoken of as existing in three forms: the nascent, represented by O; the ordinary form, O_2, and the condensed form, or ozone, O_3. It is, however, with O_2 that we have now to deal.

Oxygen in its ordinary form is a colorless, odorless and tasteless gas, constituting of the atmospheric air about 23.01 per cent by weight and 20.81 per cent by measure, being about one-fifth part. It is mixed, not combined, with the nitrogen which constitutes the remainder—almost—of the air. Its specific gravity is 1.1057, and is therefore a little more than one-tenth heavier than air; one liter of oxygen at 0°, C. (32° F.), and a barometric pressure of 0.76 meter, weighs 1.4303 gram. It is slightly soluble in water, also in alcohol. One hundred volumes of water will take up about three of oxygen, when both are at the ordinary temperature.

It is strongly magnetic; estimating the magnetism of iron at 1,000,000, that of oxygen would be 377. "Hence the magnetic power of the atmospheric oxygen is quite appreciable, being equal to that of a layer of iron covering the earth to the thickness of 0.1 millimeter."

Oxygen was formerly considered as one of the permanent gases, but in 1877 it was liquefied by subjecting it to a very high pressure (320 atmospheres) and a very low temperature (−220° F.) Later it was liquefied by employing liquid ethylene (which boils in *in vacuo* as low as −238° F.) as a means of lowering the temperature of the gas under pressure.

Still more recently, marsh gas, which has a lower boiling point than ethylene, has been utilized for this purpose. By an ingenious use of these two substances, oxygen can be liquefied at almost the ordinary pressure.

Oxygen is remarkable for the universal and energetic affinity which it possesses for the other elements. It combines with all the elements except fluorine, and with nearly all, in a direct manner; the only elements of importance with which it does not unite in a direct manner are: chlorine, bromine, iodine, fluorine, gold, silver and platinum. The act of combining with oxygen is termed oxydation; combustion is union with oxygen; it is called quick combustion when the combination is attended with light and heat, as when coal burns; slow combustion when the combination is gradual, as in the rusting of iron, forming the oxide.

When oxygen is acted upon by electricity a portion of it is changed into a colorless gas, having a peculiar odor, somewhat resembling chlorine; this, though it is regarded as a condensed form of oxygen, from the peculiar properties which it manifests, is called ozone, O_3.

In the world of arts oxygen is used for increasing the intensity of combustion, and for the production of light and heat. "In the natural world, the uses of oxygen are well-nigh infinite. Diluted with nitrogen in the air, it is continually entering and leaving chemical combinations, setting free in the former and absorbing in the latter, enormous stores of force. It is by the oxygen of respiration that the force of living beings is set free from their food; it is by the separation again of oxygen by the sunlight, that force is stored up anew in this food. Faraday has calculated that 6,000,000,000 pounds of oxygen are daily consumed in the respiration of animals; and that the daily consumption of oxygen for all purposes whatever, reaches the enormous sum of 7,142,857 tons! We have not, however, to fear an exhaustion of the supply, since the air of the globe, were no oxygen added to it, contains enough of this gas to supply this enormous demand for 480,000 years."

With reference to the proportions in which it exists in the various parts of nature it may be said that it is found in the smallest proportion in the atmosphere, of which, as already stated, it constitutes about one-fifth part by volume; water contains eight-ninths (by weight) of oxygen; one-half of the solid earth (by weight)—so far as we know it—is composed of oxygen; three-fourths (by weight) of the entire animal world, and four-fifths the weight of the whole vegetable kingdom, consist of oxygen alone.

Various Methods of Preparing Oxygen.

Various methods have been used from time to time for preparing oxygen. Those employed by the earlier experimenters were, for the most part, imperfect, and yielded an impure gas, on which account they were set aside for what, at the time, seemed better or cheaper processes. It is not improbable, however, that with our better knowledge of chemistry and improved apparatus for generating and purifying the gas, some of the early methods may be revived and so adapted or altered as to prove superior to those at present in use. In view of such probabilities a brief *résumé* of the more prominent methods may not prove uninteresting.

Ever since the discovery by Lavoisier that oxygen formed a part of our atmosphere, chemists have endeavored to devise some cheap way of obtaining a supply of it from this source, and not without success, as the methods of Téssié du Môtay, Boussingault, Mallet, Margis and others attest.

Most of the methods used depend for their supply of oxygen upon the affinity certain of the metals possess for this gas, and the ready manner with which they part with it when subjected to heat.

The following substances, when decomposed by heat — some also by the action of acids — yield varying quantities of oxygen, and have been employed for obtaining the gas: Mercuric oxide (Priestley), Baryta Boussingault), Calcium chloride and Cobalt (Fliettmann), Sulphuric acid (Deville), Cuprous chloride (Mallet), Manganese dioxide, Bichromate of Potash, Sulphate of Zinc, Anhydrous Chromic acid, etc.

The process by mercuric oxide is now only of historic interest, it being the one by which Priestley first obtained oxygen in 1774, and was also used by some of his followers. The gas produced by this method is not fit for inhalation.

Oxygen has been obtained from atmospheric air in large quantities by the process known as Téssié du Môtay's.

"It depends upon the principle that the oxides of manganese, when heated in contact with alkalies and air, are capable of absorbing the oxygen from the air, and of subsequently giving it up again if heated in a current of steam."

Hydrogen dioxide (H_2O_2) (peroxide of hydrogen), that valuable substance which is now receiving so much attention, particularly in medical and dental circles, must also be given as a source of obtaining oxygen. It is remarkable for the readiness with which it is decomposed into water and oxygen; even at a temperature of 68°F. it begins to evolve oxygen. Simple contact with some metals, such as gold, platinum and silver, will cause its decomposition without apparently altering the metals themselves.

On account of the facility with which it is decomposed, it can hardly be prepared in hot weather, nor can it well be kept pure. When kept in a slightly acid solution it is more stable.

Pure hydrogen dioxide, when decomposed gives off 475 volumes of oxygen, that is to say, the second atom of oxygen, which is retained very loosely, "separates in the form of gas, in volume 475 times that of the liquid." It is rarely obtained, however, stronger than a three per cent solution, which will give off twelve volumes of oxygen. For medicinal purposes a strength greater than this will rarely be required and in many cases even this will be too strong.

Hofmokl, Guttman, and Schwerin have asserted that the peroxide of hydrogen, when given internally, undergoes decomposition in the tissues and liberates free oxygen.

Richardson, Hofmokl, Stöhr, Dujardin-Beaumetz, Day, Clarke, Bert, Regnard, Dayton and Bayfield have given it internally with, for the most part, satisfactory results. The peroxide is now used somewhat extensively as a "Home Treatment," a small portion being placed in an ordinary inhaling bottle, and heated by setting it in a cup of warm water. The heat causes the oxygen to be given off, and it may be inhaled through the inhaling tube in the usual way.

Drs. Wallian, Clarke and others, who have used it in this way, report excellent results. The writer, never having employed it in this manner, cannot speak from personal experience.

This process of liberating oxygen from hydrogen dioxide forms the only reliable oxygen "Home Treatment" known.

We come now to consider the process which, of late years, has been most frequently employed, and the one which is to-day almost exclusively used, to obtain an abundant and economical supply of oxygen gas, namely, the decomposition of chlorate of potash.

Preparation of Oxygen from Chlorate of Potash.—Portable Oxygen Apparatus.

Potassium chlorate, $KClO_3$, melts without decomposition at a temperature of 633.2° F.; at 671° F. it gives off part of its oxygen and forms a pasty mass consisting of a mixture of potassium chloride (KCl) and potassium perchlorate ($KClO_4$).

The potassium perchlorate, when further heated, is resolved into oxygen and potassium chloride. When some metallic oxide, such as manganese dioxide, ferric oxide or cupric oxide, is added to the chlorate, it does not fuse when heated, and decomposes at a relatively low temperature without the formation of potassium perchlorate — potassium chloride resulting. The manganese dioxide remains unchanged at the conclusion of the reaction. It is probable that the metallic oxide goes through a series of oxidations and deoxidations, in other words, that it is changed to a higher oxide, and this being a very unstable body, is at once decomposed into oxygen and a lower oxide. Thus a relatively small amount of metallic oxide is sufficient to assist the decomposition of a relatively large proportion of chlorate of potash.

Among the metallic oxides which promote the decomposition of chlorate of potash, manganese dioxide (MnO_2) (black, or peroxide), being inexpensive, is the one most used. A mixture of one part of manganese dioxide to five of potassium chlorate is the proportion generally used by the writer, though it is not essential that the proportion be exact. Both chemicals should be free from impurities, finely powdered, thoroughly dried and intimately mixed. The ordinary chlorate of potash usually contains calcium chloride, and frequently other impurities; it is, therefore, desirable to use the "chemically pure" or "purified" article. It being difficult to pulverize thoroughly the crystallized chlorate by hand — and not without danger, as any admixture of organic matter is likely to cause an explosion — it had better be purchased already powdered.

Manganese dioxide also usually contains impurities, the most common being oxidized iron, carbonate of calcium, and sulphate of barium. It need not be "chemically pure," as this is quite expensive, but it should be what is known as "selected," or "high grade." This had better be purchased unpowdered, as its quality can more readily be determined than when in powder. According to the pharmacopœia, a good article should possess the following properties: "It is amorphous, and is then of a dull, grey-black color, or in masses composed of tubular, fibrous or radiating crystals having a bright metallic lustre and yielding a black powder," * * * "it is insoluble in water and weak acids," * * * "a dark, shining, crystalline appearance may be taken as an indication of a good quality."

Sulphide of antimony (Sb_2S_3) (black sulphuret) greatly resembles in appearance the manganese dioxide, and has often been mistaken for it. As it forms a highly dangerous explosive when mixed with chlorate of potash, such a mistake should be carefully guarded against. It may be distinguished from the manganese dioxide by its ready fusibility.

Charcoal is another substance which has been mistaken for the manganese dixoide, and which forms an explosive mixture with chlorate of potash. Charcoal may be distinguished by its dull black color and its light weight. It is a good rule to test the manganese before using a large quantity, by heating a little of it with the chlorate of potash in an iron spoon. If either of the above substances have been used by mistake, or the chemicals are very impure, an explosion will occur, showing that it is unfit for use. If the chemicals are pure, the mixture will melt and dry up, leaving a dark-grey residue.

Dr. W. B. Clarke, of Indianapolis, speaks highly of Fresenius' process; he says: "The Fresenius mixture is best of all, as, according to that noted chemist, the least possible amount of chlorine is evolved in the process of manufacture. He simply adds to thoroughly dried and powdered chlorate of potash $\frac{1}{1000}$ part of sesquioxide of iron."

To generate oxygen, a quantity of the prepared mixture of $KClO_3$ and MnO_2 is placed in the copper retort and the metal tube firmly fastened to it with the clamp, the tube in turn being securely attached to the wash bottles, these having previously been filled — with the exception of the first one — about half full of water. The first one should have the bottom just covered with water, say about a quarter of an inch deep. This will retain the fine particles of chemical which are carried over when the gas is being rapidly evolved and prevents their being forced over into the second bottle containing caustic soda.

It may be well to add here that all rubber tubing used to connect flask and retort with wash bottles, also that connecting the wash bottles with each other, should be cloth lined, as it has less tendency to make the gas taste of rubber than the pure rubber tubing.

Care should be exercised to ascertain that there is no obstruction in the tubing, and that the stoppers are all pressed firmly into the bottles so they may not be blown out when the gas begins to go over rapidly. The first two wash bottles standing next the empty one should be half full of a strong solution of caustic soda to neutralize the acid vapors.

Apply heat gently at first and increase gradually. No gas will be given off until the chemicals have been heated to a high degree, though some few bubbles will pass over and through the water as the air in the retort becomes heated and the moisture in the chemicals is driven out.

When the chemicals have attained a sufficient degree of heat the evolution of gas is quite sudden and forcible. The heat should now be promptly decreased, as the gas will continue to go over until the chemicals are almost exhausted.

As soon as the gas commences to go over rapidly a whitish cloud will be seen to gradually fill the wash bottles, the space above the water soon presenting a uniform light smoky appearance. If a quantity of freshly-generated gas be stored in a glass vessel it will have the smoky appearance just referred to, but after standing a while this will entirely disappear and a fine, crystalline deposit can be seen upon the sides of the vessel. If this deposit be examined microscopically it will reveal fine crystals of the chlorate of potash.

Dr. Andrew Smith, in referring to this phenomenon, says: " It would seem, then, that a small portion of the chlorate, instead of being decomposed by the heat, is sublimed unchanged, and such is its insolubility that it is not separated from the gas except by repeated washings. Not the least harm results, however, from inhaling it as I have demonstrated repeatedly on my own person."

When the gasometer which is used for storing oxygen is freshly filled, the lower portion which has been standing in the water, will be found dotted over with white crystals the same as seen on the glass vessel previously mentioned. I think it best to allow the gas to stand from one to three hours after it is made before using.

To return to the generating — as the bubbles begin to pass more slowly the heat should be again increased in order to thoroughly exhaust the chemicals. The evolution of gas ceases rather suddenly and when this occurs it is useless to apply heat longer as no more will pass over.

At this juncture the gas must be promptly shut off at the gasometer and the retort disconnected from the wash bottles before the heat is removed.

When the retort has cooled it should be filled with water to dissolve the remaining chemicals, and it must be well rinsed and thoroughly dried before using again. The metal tube to the retort should also be cleansed of particles of chemical which are often driven into it by the forcible evolution of the gas.

One pound of the mixture of chemicals for generating oxygen will furnish about thirty gallons of gas.

The length of time required to generate a given amount of oxygen will vary with different chemicals, and with the same chemicals according to the amount of moisture contained.

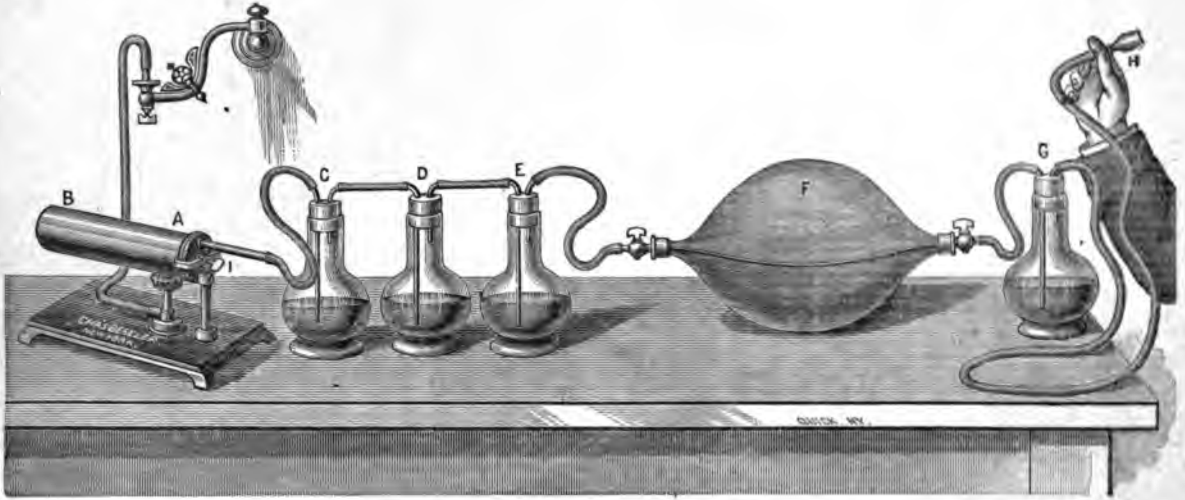
It will require from a half to three-quarters of an hour to heat one pound of chemical to the temperature at which the evolution of gas begins, after which time it will take from three to six minutes to completely exhaust it.

Dr. Smith has devised a convenient portable apparatus which is so arranged that the evolution of gas is under perfect control. In place of the usual pear-shaped flask, he employs one made in the form of a cylinder, nine inches long and one and a quarter inches in diameter. The open extremity of this flask has a flange around the edge, to which the cover, having the outlet tube attached, is clamped, in a similar manner to the regular retort. This retort, when in use, is in a horizontal position, the outlet tube being passed through the wash bottle cork into the water, the retort being at right angles with the bottle.

When generating, the chemicals are distributed on the bottom along the entire length of the cylinder. The heat is first applied near the outlet extremity, and as the chemical in that portion of the retort is exhausted, it is moved along toward the opposite end. In this way only a small part of the chemical is heated at once, and the evolution is under perfect control. Generation can be stopped at any time, leaving the remainder of the chemical in a condition for future use.

The accompanying cut shows a very convenient, portable apparatus made after the general design suggested by Dr. Smith, though much improved by enlarging the cylinder — two inches in diameter by twelve inches long — and the addition of several wash bottles for purifying, a rubber gas-bag for storing, and an inhaling bottle with flexible tube and mouth-piece for administering.

The following are the directions for using this apparatus: The retort is to be half filled with the chemicals which must be distributed along its whole length. Wash bottles C and D should be half filled with a solution of caustic soda, and wash bottles E and G with clear water. The gas burner should be placed under the retort at A and moved along toward B as the chemicals become exhausted.


B
A
I
C
D
E
F
G
H
CHAS BESELER
NEW YORK

The retort will admit one pound of the chemicals, which will be sufficient to generate thirty gallons of oxygen.

The gas bag should be detached from the wash bottle E until the gas begins to pass over. Extinguish the light as soon as the gas bag is filled.

The oxygen is now ready to be inhaled, or (if preferable) may be stored in the bag for future use.

A cylindrical retort, such as shown in the figure, if made of sufficient size, will work equally well with a larger outfit, and would undoubtedly be safer, as by heating a small portion of the chemical at once, the violent and irregular rush of gas, such as often occurs when the ordinary retort is used, is obviated. But by exercising proper care in selecting and preparing chemicals and regulating the temperature, the writer has, up to the present time, found no adequate reason for discarding the time-honored retort.

Oxygen Physiologically Considered.

The old writers and investigators, such as Priestley, Lavoisier, and others, held that inhalations of pure oxygen had always a greater or less tendency to set up inflammatory conditions in the body. Modern experiments by A. H. Smith and others show that the fatal results heretofore observed — in the case of animals confined in jars filled with oxygen—as well as the peculiar post mortem appearances, were the result of the admixture of the products of respiration with the gas inhaled and not caused by the oxygen itself. It is now, moreover, an admitted fact that the blood can be made to take up an increased supply of oxygen, when this agent is exhibited by inhalation, in a proportion greater than is ordinarily found in atmospheric air, and though we concede that the quantity is not large, we find that this added portion, being present in the blood at a *greater tension*, may be of far more importance to the organism than the larger quantity normally present. If the assertion of Wallian and Birch is correct—and my own experience tends to corroborate it—this small quantity is capable of making a profound impression upon the tissues and greatly influencing diseased conditions.

The two factors which greatly influence the absorption of oxygen are pressure and temperature. A high pressure and a low temperature greatly facilitates its entrance into the body. The pressure, however, can only be advantageously increased within certain limits, as is shown by the following extract: "At a pressure of four atmospheres of oxygen, corresponding to twenty atmospheres of air, and upwards, a very remarkable phenomenon presents itself. The animals die of asphyxia and convulsions, exactly in the same way as when oxygen is deficient. Corresponding with this it is found that the production of carbonic acid is diminished. That is to say, when the pressure of the oxygen is increased beyond a certain limit, the oxidations of the body are diminished, and with a still further increase of the oxygen are arrested altogether. The oxidation of phosphorus is quite analogous; at a high pressure of oxygen phosphorus will not burn. Not only animals but plants bacteria, and organized ferments, are similarly killed by a too great pressure of oxygen." (Foster's Text Book of Physiology.)

The last sentence affords us another valuable hint with reference to the destruction of bacteria, etc.

The quantity of oxygen consumed, the condition influencing consumption, the amount present in the blood and tissues and its relation to the amount of carbonic acid exhaled have been made the subject of many experiments.

The amount of oxygen absorbed varies greatly, depending upon the condition of the digestive system, muscular activity and temperature.

There is a marked increase in the consumption of oxygen, by human beings, at low temperatures. More is consumed during digestion than when fasting; when exercising more is consumed than when not.

With reference to the quantity of oxygen in the blood, and the relative difference between arterial and venous blood Foster gives the following figures:

From 100 vols.		**may be obtained**	
	Of oxygen,	**of carbonic acid,**	**of nitrogen**
Of Arterial Blood,	**20 vols.**	**40 vols.**	**1 to 2 vols.**
Of Venous Blood,	**8 to 12 vols.**	**46 vols.**	**1 to 2 vols.**

all measured at 760 mm. and 0° C.

"That is to say, venous blood, as compared with arterial blood, contains eight to twelve per cent less oxygen and six per cent more carbonic acid. But the gases of the venous blood are much more variable than those of the arterial blood."

According to Flint, "the proportion of gases in the blood is found to vary very considerably under different conditions of the system, particularly with reference to the digestive process. * * *

Arterial blood, while an animal is fasting, contains from nine to eleven parts per hundred of oxygen. In full digestion, the proportion is raised to seventeen, eighteen, or even twenty parts per hundred. The proportion varies in different animals, being much greater, for example, in birds than in mammals."

Dr. Smith, after numerous experiments, and a considerable experience says:

It is contrary to the economy of Nature that the blood should have the capacity for absorbing more oxygen than Nature can supply. My view is, then, that if pure oxygen be taken into the lungs, only as much will be absorbed by the blood as would be taken up from the air under circumstances involving the greatest possible physiological demand for oxygen.

Foster's observations concerning the amount of oxygen present in the tissues, particularly in the muscles, will render evident the fallacy of estimating the quantity found in the blood as the whole available supply.

The stowing away of oxygen in the tissues as a reserve force, to be utilized at some future time when increased physical activities demand for their production and maintenance greater quantities of oxygen, or perhaps to make up for a deficiency in the supply of this ever-needful agent, is another beautiful example of the wise provision against possible contingencies which Nature is ever affording. May it not be probable that upon the amount of this intra-molecular oxygen depends our well-being? When but little of it is present we are easy prey for disease, while an abundance of it is Nature's great prophylactic.

Many interesting and instructive experiments have been made to determine the direct influence of oxygen on the heart; also on other muscular and nervous tissues.

Mr. Erichsen found, in experimenting on asphyxiated animals, that ventricular contraction could be re-excited by oxygen when ordinary air had no effect. According to Hermann, oxygen is not indispensable for the cardiac contractions — they may occur without it, but irregularly; and if the gas be absent, or supplied in insufficient quantity, regular and synchronous contractions are impossible.

Brown-Sequard, in his experiments, succeeded in restoring vitality to muscular and nerve tissue which had for some time ceased to exhibit any sign of vital properties, by injecting freshly oxygenated blood.

We come now to consider the relations between the quantity of oxygen consumed and the quantity of carbonic acid formed. It has been found that the relation is not definite, and that the variations are influenced by much the same conditions, as produced alterations in the amount simply of the oxygen consumed. Thus Flint says: "We have already noted that from one-seventieth to one-fiftieth, or about 1.4 to 2 per cent, of the inspired air is lost in the lungs or it may be stated,. in general terms, that the oxygen absorbed is equal to about five per cent of the volume of air inspired, and the carbonic acid exhaled, only about four per cent."

Foster puts it in this way: "The expired air contains about four or five per cent less oxygen, and about four per cent more carbonic acid than the inspired air, the quantity of nitrogen suffering but little change. Thus—

	Oxygen.	Nitrogen.	Carbonic acid.
Inspired air contains	20.81	79.15	.04
Expired " "	16.033	79.587	4.380

The quantity of nitrogen in the expired air is sometimes found to be slightly greater, as in the table above, but sometimes less than that of the inspired air.

Various theories have been advanced to account for this discrepancy. The following quotation from Bence Jones (Kirke's Hand Book of Physiology) offers a plausible explanation of this phenomenon.

"The quantity of oxygen that does not combine with the carbon given off in carbonic acid from the lungs is probably disposed of in forming some of the carbonic acid and water given off from the skin, and in combining with sulphur and phosporus to form part of the acids of the sulphates and phosphates excreted in the urine, and probably also, with the nitrogen of the decomposing nitrogenous tissues."

Some experiments have been made upon the influence which oxygen exerts on the amount of urea excreted.

Dr. Smith sums up his experiments upon this point in the following words: "So far as these experiments go they indicate that oxygen causes a *decrease* in the amount of urea formed. This is surprising, if we are to consider urea as the result of oxidation of tissue, as is generally held. More extended observation is required before it would be warrantable to call in question the views so ably enunciated upon this point; but should it be established that the continued use of oxygen really diminishes the excretion of urea, it would place the latter substance in analogy with the smoke resulting from combustion, a product, it is true of the combustion, but at the same time a measure of the incompleteness of the process.

"The quantity of uric acid in the urine is rapidly diminished by the use of oxygen. This fact, suspected by Dr. Golden (Lancet, March 10, 1866) has been fully established by Kollman of Munich."

Other observers have reported that the elimination of uric acid during a course of oxygen inhalation is markedly lessened, i. e., that more complete combustion occurs within the system (Schmidt's Jahrb., 1865, t. 1, s. 28); thus, Kollmann found that while 300 grammes of the ordinary secretion of urine contained 236 milligrammes of acid, the same quantity contained only 122 milligrammes after inhalation of twelve litres of oxygen On another occasion the amount of acid came down from 134 milligrammes to 25 milligrammes. (Phillip's Mat. Med. and Ther.)

The effect of inhaling considerable quantities of pure oxygen varies greatly in different subjects: some will inhale a number of gallons without any apparent effect; it usually, however, causes a slight feeling of warmth about the chest, which may or may not gradually pervade the entire body, giving a sensation of warmth to previously cold hands and feet. The respiratory movements seem to be accomplished with greater freedom. Some exhilaration, with perhaps a little vertigo, or confusion about the head, may be experienced. Occasionally a tingling is felt in various parts of the body, particularly in the finger-tips. The pulse usually rises a little, though it often falls, and sometimes is but little if any affected.

Hausemann mentions the symptom of pain in the region of the fifth nerve. I have at times had my patients complain of a peculiar sensation in the frontal region. I have not observed any rise of temperature, but frequently found it to decline in patients with fever. The general feeling is one of restfulness and comfort, sometimes a buoyancy similar, but in a less degree, to that experienced after taking nitrous oxide, is felt.

One thing noted by all the experimenters with gas, from Priestly down to those of the present day, is the decided and beneficial influence which it exerts upon the digestive system. It stimulates the appetite, improves digestion, and induces healthful and regular action of the bowels.

Demarquay and his associates, in studying the effects of oxygen, observed that all who took the gas daily for some time noticed improvement of the appetite, a general sense of well-being and increased energy. Various sick persons derived great benefit from respiring " twenty-nine or thirty quarts daily."

Hausemann found " that in many healthy persons no marked effect is to be noted from inhalations of fifteen to thirty litres of oxygen, unless it be a sense of warmth in the mouth and at the epigastrium." (Phillips' Mat. Med. and Thera.)

Naoumoff and Beliaieff, breathing it for seven to seventeen minutes, found no appreciable change in pulse or temperature, whilst in dogs made to breathe alternately air and oxygen, the temperature rose sometimes with the latter to a few tenths of a degree, and there seemed some dilatation of capillaries. (Lancet, i., 1875. (Ibid.)

Mr. Savory, in his experiments upon animals, found no increase of temperature during oxygen inhalation.

I have myself repeatedly inhaled, and caused others to inhale, from two to ten gallons of oxygen at a single sitting, without any ill effect. These and many similar experiments demonstrate the fallacy of the old claim that breathing oxygen will cause inflammation and other dangerous symptoms. It must not be inferred from this that I believe the prolonged use of pure oxygen either beneficial or advisable; it is very far from my intention to advocate its use in this way; these facts are brought forward simply to disprove the old mistaken notions which unfortunately have been handed down to our present day and are still used as an argument against the use of oxygen as a remedy. The matter of dosage will be considered in the chapter on administration, etc.

Preparation of Nitrogen Monoxide.

Ammonium nitrate, NH_4NO_3, is used for generating nitrogen monoxide, heat decomposing it into nitrogen monoxide and water. The crystallized, granular or fused salt may be employed, there being little difference in their product if the chemical is pure and dry. The granular is the most convenient to handle, as it will need no powdering, and is rather nicer to manipulate.

Owing to the tendency of the salt to deliquesce when exposed to moist air, it should be kept in a dry place and tightly covered. If this precaution is not taken, the ammonium nitrate will attract sufficient water to cause it to harden or cake when exposed to a high temperature, and also create much annoyance from the presence of water when generating. It should be perfectly free from chloride lest chlorine be evolved and become mixed with the gas when the chemical is heated.

The ammonium nitrate fuses at about 226° F., and if gradually heated, decomposes into nitrogen monoxide and water at 329° F. If the heat is rapidly applied it decomposes into water, nitrous acid and nitrogen, or into nitrous and nitric oxides, nitrate of ammonia, and ammonia.

The following are tests for its purity: "The salt should be completely volatilized without charring when heated on platinum foil, and its aqueous solution should not be precipitated either by silver nitrate or barium chloride (absence of the chloride and sulphate)."

Place the desired amount of ammonium nitrate in the Florence flask, cork well. If the cork does not fit tightly into the neck of the flask wire it down, to prevent it being blown out. The second wash bottle should have dissolved in it sufficient sulphate of iron to make a pretty strong solution; this will absorb any nitric oxide or other of the higher oxides of nitrogen which may pass over. The next wash bottle should contain a strong solution of caustic potash, to absorb acid vapors and chlorine.

Another method of purifying is by using in the second wash bottle a strong solution of ferrous sulphate (copperas) to which commercial sulpuric acid in the proportion of two gallons to the ounce is added; this solution is only renewed as it becomes foul, which is indicated by its gradually becoming a darker color.

The flask must be securely connected with the series of wash bottles in the same manner as in making oxygen. Heat should be applied cautiously at first until the flask is evenly warmed through, when it may be increasd. The ammonium nitrate will slowly melt until the whole mass has assumed a fluid form. If the chemical is pure the fluid will be perfectly clear, and has very much the appearance and consistency of simple syrup. Often, however, there will rise to the surface a yellow or blackish film, owing to the chemicals not being perfectly clean. When this occurs, time and trouble will be saved by disconnecting the flask from the wash bottles and allowing the chemical to boil energetically for a few minutes; this eliminates the superfluous moisture and part of the acid vapor, as well as the foreign matter which causes the discoloration. In this procedure some gas is of necessity wasted, but it enables us to maintain the chemicals at a higher temperature afterward, with less danger of driving over the acid vapor and hence greatly facilitates the generation.

As soon as the chemical is entirely melted the heat must be decreased somewhat and contents allowed to come slowly to the boiling point, when gas is abundantly given off. The heat must now be carefully regulated and the temperature maintained at about 329° F. As it is impracticable to regulate the heat by means of a thermometer, the proper temperature can only be judged by the action of the chemical. At the first appearance of any white fumes passing over into the wash bottles, the heat must be at once diminished.

When the chemical first begins to boil some trouble may be experienced from a vaporous condensation upon the cork and in the tube, dropping back into the liquid, causing a commotion in the boiling chemical and a consequent rush of gas and formation of a whitish vapor which obscures the chemical from sight. This may be partially obviated by suspending the flask so that it is higher than the wash bottles, with the top inclined toward them, thus causing the condensation in the tube to drain into the wash bottle and that from the cork to trickle gently down the side of the flask.

Nitrogen monoxide, as before stated, goes over much more slowly than oxygen — it requires almost two hours to exhaust one pound of ammonium nitrate, and this quantity will give a little less gas than the same quantity of chemical for generating oxygen.

The process of generating this gas cannot be much hurried; if pushed beyond a certain point, the result will surely prove disastrous, and it may be well to bear in mind the old maxim, "the more haste the less speed."

The chemical will work more satisfactorily, and the entire process be materially expedited, if the heat is gradually applied, and always diminished short of the point when the white vapor begins to go over. It will require a little practice to determine the maximum heat which can safely be employed, but a brief experience will enable the operator to judge correctly this limit.

The neophyte will doubtless marvel at the mysterious manner in which his freshly-generated gas vanishes, and unless he bethinks himself of the properties of nitrous oxide, he may be at a loss for an explanation of the peculiar way in which the bell of his gasometer descends during the night.

The solubility of this gas will account for its disappearance, water at the ordinary temperature taking up about three-fourths of its volume of nitrous oxide. It will therefore be seen that considerable gas will be required to completely saturate all the water in the gasometer, and the water will continue to absorb it for some time.

In connection with this it may be well to again call attention to the effect of a low temperature upon the gases. Both contract perceptibly — the nitrous oxide much more than the oxygen — when exposed to the average winter temperature. This will be brought strikingly to mind when they are transported in gas bags during the cold months. If a rubber gas bag be filled with the commingled gases in a warm room, and afterwards taken out into the cold, the bag will very soon collapse and give the impression to the uninformed that about one-half of the contents has leaked out. As soon as exposed to a higher temperature the gas will expand and again fill out the bag.

The water in the gasometers ought to be changed every few weeks if much gas is being generated. It need not be all changed at once, but one or two bucketfuls can be drawn off from time to time and replaced with fresh water.

"Compound Oxygen" and "Oxygen Home Treatment."

So much has been said about "Compound Oxygen," and "Oxygen Home Treatment," that it may be well to devote some space to its consideration.

During the past few years, the papers and journals, secular, religious and scientific, all over the country have contained flaming advertisements of compound oxygen, in which it is lauded as the great specific for all the ills of man.

The extensive sale of the oxygen home treatment and astonishing claims made for it have induced many chemists and physicians to inquire into its alleged virtues, and determine the ingredients which compose it. The formulæ of both the home and office treatment have been published in various journals (Boston Journal of Chemistry, Medical Record, The Health Record, and others).

Dr. Wm. B. Clarke, of Indianapolis, Ind., has published a little pamphlet entitled "An Oxygen Expose," in which he relates his experience with compound oxygen. He was induced by one of the traveling "oxygen doctors" — so numerous in the West — to purchase the formulæ for preparing the office and home treatment.

In the following extract Dr. Clarke makes public the formulæ which he was assured were identical with those employed by the notorious "Compound Oxygen" firm of Philadelphia:

"As I am likewise under no promise not to divulge any information, I herein furnish all who read 'free gratis, for nothing,' the great Lennard formulas. Punctuation, spelling, capitalizing are as he wrote, and poorly wrote. The originals may be seen at any time by any one.

'COMP. OXYGEN TREATMENT.

℞ Nitrate Amonia	25 parts.
Carbonate Ferri	1 part.

Mix, put in Retort, apply gentle heat, till whole Compound becomes to a boiling heat, then add heat gradually, and conduct Oxygen to the Tank.

'HOME TREATMENT OF OXYGEN.

℞ Nitrate Amonia	1 ounce.
Chlorate Potassa	1 dram.
Alcohol	2 ounces.
Aqua Disliled	14 ounces.

Mix, one teaspoonfull to Inhaler full of hot water. Inhale 2 or 3 times a day.'

"As to this 'office treatment,' a glance at the formula shows it to be nothing but 'laughing gas.' The carbonate of iron is simply a blind, skillful or bungling as the case may seem; in other words to give color to the chemicals and to the boiling liquid, and thus render them less easy of recognition. It does not modify the ultimate product. (Not entirely satisfied with my own conviction on this point of modification, I have consulted two chemists, both professors of chemistry in medical colleges, one here and one in Chicago, and each say that I am right.)

"Dr. Lennard's office oxygen treatment is nothing but laughing gas, and an impure article at that, as the gas passes through three wash-bottles containing nothing but water."

Dr. Walman, in speaking of Dr. Ziegler's work says: " Later, some enterprising but unscrupulous pretenders "discovered' in this gas the so-called 'oxygenized air' which a dozen years ago was extensively advertised as a cure-all. 'Rights' to manufacture and administer it (?) were sold to gullibles for a round sum, the process of generating it being bunglingly disguised by the addition of ferric carbonate or other inert coloring material to the ammonium nitrate used. Even to this day a firm in Philadelphia is still harping on the miraculous alchemy of 'Compound Oxygen.' What their office remedy may be I do not know, but the trash they send to their mail correspondents, calling it 'home treatment,' is a barefaced swindle and utterly worthless, being nothing more than a weak solution of nitrates of lead and ammonium, or of ammonium muriate and St. Croix rum. (Some adding also chlorate of potash.) * * * It (N_2O) is the basis of the 'well-kept secret,' for years so successfully vaunted by the polished and oily-tongued quacks as 'Compound Oxygen'; and, it must be admitted, that in connection with some wholesome hygienic rules persistently inculcated, these advertising professional outlaws have really performed some therapeutic, as well as *moral*, wonders by its aid."

Personally, the writer has had no experience with the oxygen "home treatment," or its preparation, though he has had excellent opportunities of observing the preparation and administration of the office treatment. Of the half dozen oxygen parlors to which he has had access, he can state with certainty that in every instance the gas was manufactured from nitrate of ammonia, to which was added a varying quantity of ferric carbonate.

He is bound to acknowledge that he has seen some excellent results follow from its administration, as one of the most successfully treated cases of phthisis which the author is able to report is that of a lady who owes her recovery to the use of the so-called compound oxygen.

The objections to compound oxygen are:

1.—That there is no such thing as compound oxygen.

2.—That the handling of the substance bearing this name has been confined almost entirely to persons without any knowledge of medicine or other qualifications requisite to the administration of such an agent.

3.—That the formula has been retained as a secret which was only made known for precuniary considerations.

4.—That it has been advertised in an unprofessional, not to say unprincipled, manner.

5.— Finally, as to the home oxygen treatment, it may be said that there is no chemical or combination of chemicals known — except hydrogen dioxide, which has not been found to be an ingredient of their formula — which will evolve oxygen after the manner directed by the venders of the home treatment for its use.

In the chapter on "Various methods of preparing oxygen," we have described the manufacture of oxygen from hydrogen dioxide.

Commingling the Gases.

Having secured a supply of both oxygen and nitrogen monoxide, it will now be necessary to commingle them in suitable proportions for administration.

If the outfit consists of three gasometers it will be necessary to fix upon some standard proportion which will be suitable to the largest number of cases. Probably the one which has been several times referred to will meet the requirements as well or better than any other, namely; oxygen, one volume; nitrogen monoxide, one volume; atmospheric air, two volumes.

Fully two-thirds of the cases treated by the writer have taken this mixture, varied, as may have been required, by an occasional inhalation of the pure oxygen or nitrogen monoxide.

Supposing the gasometer which is intended for the commingling to be empty — the air having been forced out by raising the weight and allowing it to descend until the bell is entirely filled with water—the gases are commingled as follows: The height of the oxygen bell is noted by the scale upon it, the stop cocks in the tube communicating with the empty gasometer are then opened, the weight raised and the oxygen bell allowed to descend by its own weight until the required amount has been forced into the other gasometer. The gas is then shut off, and the nitrous oxide transferred in the same manner.

We now have equal parts of the two gases, and it only remains to add the air. If the outfit comprises an air pump and receiver, this is quickly done by compressing the air in the receiver to about twenty pounds pressure, and connecting it with the gasometer by means of a rubber tube.

Now again note the height of the bell, and allow the air to escape from the receiver until it attains a height equal to that previously marked by the two gases.

If the outfit does not include an air pump and receiver, the air must be added by opening one of the inlets communicating with the air and depressing the weight until the proper amount has entered.

Administration and Accessory Treatment.

ADMINISTRATION.—If the time of administering can be regulated — which it cannot, always — the patient should be advised to take the treatment as nearly as possible midway between meals, or at least not immediately before or after meals. Failing to induce him to conform to the most suitable time, give it at any hour rather than forego the treatment.

I prefer to have patients take it when they can feel most at leisure, even if that time should be just before or after a meal.

Discourage at the outset all tendency to hurry the treatment, and endeavor to impress the patient with the necessity of following the prescribed rules, giving as a minimum time five minutes between inhalations.

Overworked business men may form a goodly proportion of your patients, and it is often the case that they come to the office in a hurry, anxious to take a few inhalations as speedily as possible, then hasten off directly the last one is completed. This is a most unsatisfactory method for patient as well as physician, and must not be permitted.

To the business man we would say, " make *this* your business. Nothing can be of more importance to you now, and everything depends upon your taking the treatment properly."

Cheery, well-lighted rooms, neatly kept, furnished with a goodly number of easy chairs, a few plants, something in the way of reading matter, particularly a few daily papers and monthly periodicals, will make the necessary time of waiting pass more quickly and pleasantly. It is best to sit awhile after a treatment before again going out into the open air.

Do not under any circumstances hurry the treatment, even though the waiting-room be full of patients. Thorough, careful treatments will bring their own reward.

As soon as practice warrants it, provision can be made so that two or more patients may be receiving attention at the same time. This can be arranged by conducting the gas to different apartments or by having several inhaling tubes tributary to a main conducting tube.

Treatments are generally given daily, and sometimes twice a day. In important cases, where no contra indications exist, two small treatments are better than one large one.

When possible, the gas should be administered to patients while standing erect, but when their strength will not admit of this, it can be given in a sitting or recumbent posture.

Preparatory to the inhalation the shoulders should be thrown well back and the patient instructed to as thoroughly as possible expel the air from the lungs, then taking the mouth-piece between the lips slowly inspire until the lungs are well filled. The gas should be retained as long as possible without giving discomfort, then slowly expired.

Many patients will take air through the nose when inhaling unless that member be held between the thumb and finger.

Well-advanced phthisical cases should be cautioned against using any undue effort in either filling the lungs or retaining the gas, as such an effort might be instrumental in inducing a hæmorrhage.

The first treatment should always be small, and consist of the well diluted gas; the quantity and strength may be increased as the case demands. Occasionally two inhalations of the modified gas will be all that is allowable at the first treatment, and indeed, thereafter, with some patients.

Except in cases as above mentioned, the patient may be permitted to take as much in a single inhalation as chest capacity will admit.

"In practice, a great difference will be found in different persons in the readiness with which the gas appears to be absorbed and in the quantity required to produce a given effect. It is possible that this may be owing, at least in part, to the fact observed by Chevreul, that oxygen is more rapidly absorbed when the blood is more than usually alkaline. This suggests the propriety of using alkalies moderately in cases in which the oxygen does not seem to be easily absorbed, provided their use is not contra-indicated. It is possible that by their aid oxygen might be used successfully when it would otherwise fail to produce the desired effect."

As a general rule, a treatment will consist of from two to eight inhalations a day.

After becoming a little accustomed to the treatment, and particularly if taking the gases well diluted, patients may clamor for a larger quantity, or "something stronger." These demands should never be acceeded to simply to please the patient. Those who have once tasted the nitrous oxide, and enjoyed its mildly intoxicating effects will with difficulty content themselves when taking the diluted gases. For this reason it should not be given to amuse your patients, but only when indicated.

Unless there are palpable signs of improvement, patients may require some reassuring to convince them that the quantity and quality is just the thing. Fortunately, however, the results of treatment are usually self evident.

When tendency to hæmoptysis exists it is well to administer the gas with caution lest a hæmorrhage be induced. I have not, however, noticed the slightest tendency of the oxygen to cause such trouble. A careful observance of the general rules laid down for the administration will be all that is necessary.

Patients suffering from phthisis, asthma, or other affections accompanied by nightly aggravations, will do well to take a few inhalations previous to retiring. As nitrous oxide possesses a most quieting influence upon the nervous system, and a strong tendency to induce sleep, these treatments should consist largely of this gas.

In asphyxia, resulting from inhaling carbonic oxide, carbonic acid, water or coal gas, sulphuretted hydrogen, sewer gas, etc., etc., pure oxygen will be required. No definite rules can be laid down for administering; the quantity must be left to the judgment of the physician, he being governed entirely by the effect produced.

In poisoning by Chloroform, Ether, Hydrate of Chloral and Gelsemium, the pure oxygen in liberal quantities is indicated. In puerperal eclampsia, epileptic, infantile uræmic convulsions, obstructed respiration in diphtheria and croup, paroxysms of asthma and suspended animation of the new-born, pure oxygen is also demanded, and may be freely administered.

To meet these emergencies an abundant supply of gas should always be kept on hand. One or two rubber gas bags should also be in readiness for such occasions.

A physician having the oxygen at his command should make it a point to acquaint his brother practitioners with its valuable properties, particularly in the above mentioned cases, and in every way possible encourage its introduction.

A standing offer to immediate professional acquaintances to furnish the gas gratis for all emergency cases might prove a most excellent plan of introducing it, and redound greatly to one's credit and in the end to his pecuniary advancement.

It should be the honest endeavor of every physician using the oxygen to give it the standing in the profession which it deserves, and to this end all quack methods of employing or advertising it should be scrupulously avoided. The action and effect of the oxygen should be explained and illustrated to medical men, as frequently as legitimate opportunities are afforded, but its claims must not be set forth in too extravagant a manner, since more harm than good might result from over-enthusiasm.

A careful record of all cases treated should be kept, and the progress as to pulse, respiration, chest capacity, weight, appetite, color, etc., regularly noted. In case of pulmonary affections a thorough physical examination should be insisted upon before commencing the treatment, as only by so doing can the exact progress be determined.

Urinary tests should be frequently instituted, and the quantity, specific gravity and reaction ascertained.

When first commencing the oxygen, and particularly if the early treatments be large, urinary deposits will often be found.

ACCESSORY TREATMENT.—The oxygen treatment in no wise interferes with the action of well-chosen remedies, but on the contrary, will enable the system to more readily respond to them.

Undoubtedly many physicians, like myself, when first commencing the use of oxygen, will prefer to test its efficacy unaided by other remedies, thus verifying the claims which have been made for it. The beginner is certainly excusable for this, but its use in a few well-chosen cases will suffice to demonstrate its value, and leave no excuse for not availing one's self of other established therapeutic as well as hygienic measures in connection with the oxygen, in fact, nothing should be neglected which is considered of use in the ordinary methods of treatment.

Two things I would insist upon as quite necessary, namely, frequent bathing, and the ingestion of considerable quantities of fluid. The liberal use of water, both internally and externally, I consider an indispensable adjunct. The free and prompt elimination of morbid products liberated by oxygen is of the utmost importance, hence the excretory functions should be promoted in every possible way. And few things conduce more to the healthy and vigorous action of the kidneys, urinary passages and skin than a generous supply of water, which by its solvent and depuratory action greatly hastens tissue metabolism, and the elimination of worn out material.

The entire organism should be treated to repeated flushings to dissolve and wash away the products of malassimilation and waste. To realize how much water is needed and should be supplied to the organism, we have only to call to mind the familiar fact that three quarters by weight of the entire body is composed of fluid.

When the morbid products have been accumulating in the system as a result of disease, or simply of a lowered vitality, the quantity of water taken should be even greater than in health. Effete matters are deposited as solids, or semi-solids, and can only be removed by the solvent action of the bodily fluids.

A writer in the Lancet asserts that uric acid requires not less than eight thousand times its bulk of water to hold it in solution, and if not perfectly dissolved it becomes crystallized, and is responsible for many such diseases, as gout, gravel, etc.

The same authority says that there is good reason to suppose that diseases of the kidneys are caused by the products of disassimilation reaching the kidneys in too concentrated a form.

Many of the solids of tissue-waste are of a nature which irritate and even disorganize the kidneys. Hence the necessity of having them dissolved and diluted.

It is further asserted that those who habitually drink large quantities of unstimulating fluids, rarely suffer from diseases affecting the excretory functions. No other fluids will take the place of water—that universal solvent and purifier.

The practice of drinking hot water about an hour before meals I would strongly commend as an aid to the digestive and excretory functions, and in this connection I will say do not use water that has stood simmering for hours in a tea kettle, but take a clean vessel, fresh water, and bring it briskly to the temperature required, in this way rendering it far more palatable than by using the stale product of the ordinary tea kettle. If this rule is observed the repugnance and nausea experienced by many will soon pass away. Should it, however, not be overcome, hot lemonade, soda or some slightly flavored water may be substituted.

The oxygen will supply, to a considerable extent any deficiency in the matter of exercise or out-door air, but it cannot atone for the want of fluids so necessary to carry off the products of retrograde matamorphosis,

There need be but little fear of taking too much water, as any excess is readily disposed of by the kidneys, skin and lungs.

The importance of this subject is my reason for dwelling upon it at such length, and shall be my excuse for further continuing it by quoting a portion of a most excellent article on "The Dietetic Value of Water," by Geo. B. Fowler, M. D., of New York, in the Journal of Reconstructives, April, 1886. The article exactly voices my sentiments upon the point in question, and also touches another important matter in this connection, namely, that of the frequent substitution of stimulating liquids for water, and impels me to quote entire the closing portion of the paper.

One of the opening assertions is as follows: "I venture the statement that the cause of one-fourth the cases of disordered digestion in fashionable life is a lack of sufficient water in the dietary." And in the closing paragraph adds:—

"Water gives mobility to the fluids, dissolves and carries in solution the various substances intended for nutrition or destined for excretion. It supplies rotundity and flexibility to the body as a whole; strength and elasticity to the muscles, bones, ligaments and cartilages through its agency exchange of matter and tissue metabolism is effected. In short, I repeat, it is only by the presence of water in proper proportion in all the tissues and fluids of the body that the physiological phenomena which characterize health can take place. Milk, the sole food of animals during a period of most active physiological changes, contains eighty-five per cent of water.

"A healthy adult excretes about ninety ounces of water per day, as follows:

Lungs	14 ounces.
Skin	26 "
Urine	50 "

"That means that these proportions must be supplied in order that the vital processes may operate effectively and normally.

"How is it done? Fifteen or twenty ounces are combined with the solid food, and therefore we must take as beverage each day seventy or seventy-five ounces.

"The habitual substitution of wines, malt liquors, etc., for water is pretty sure in the long run to result in evil in the majority of cases. For, in the first place, where pure or undiluted wine is drunk the individual is not disposed to take enough to supply the system with the requisite amount of fluid, and if he should everything is upset by the pernicious effect of the contained alcohol. Beer, though containing less alcohol, is open to the same general objections. It should never permanently, or for any lengthened period, be allowed to take the place of pure water. All these beverages are unnatural solvents; besides water they contain many ingredients intolerant to most alimentary canals. Especially is this true in those persons already suffering from deranged digestion.

"Water taken at meals in quantities sufficient to satisfy the thirst acts only beneficially. Indeed, an excess will not hurt; for it is quickly absorbed, and increasing the blood pressure favors digestion by thus inducing a freer flow of the juices. It is a digestive agent as well as a food. By the liberal use of water as a beverage the feces are rendered of proper consistency, the intestines maintain their normal activity, and constipation is avoided. The passage of from thirty-five to fifty ounces of urine each day, the result of the ingestion of pure water, tends to keep the kidneys and urinary passages clear of concretions and morbid changes, and with the skin and lungs equally active, the bodily house is well swept. The same result is impossible with artificial beverages. He who stints himself in the drinking of water is dirty inside."

The writer must confess to feeling a strong temptation to dismiss the whole subject of diet with the stereotyped phrase "the diet should be highly nutritious." And indeed, under the circumstances it is impossible to be explicit, as the oxygen treatment is not here recommended in any single disease or class of diseases, but rather for morbid affections in general. Therefore an attempt to lay down rules of diet to be used in connection with its administration, would amount to little less than a review of the whole field dietetics.

It would be a reflection upon the intelligence of my readers to give a summary of the information contained in any work on dietetics concerning the amount of nitrogenous matter, carbo-hydrates, fat, mineral matter, etc., to be given, all of which had been calculated from a table giving the percentage composition of different articles of food.

Use of Oxygen and Nitrogen Monoxide Combined.

Nitrogen monoxide (N_2O)—Nitrous oxide—laughing-gas, is a colorless, transparent gas, having a peculiar sweetish taste and smell. The specific gravity of the gas is 1.527—of the liquid 0.908; boiling point—88° freezing point—101°. It is soluble in water, alcohol, ether, volatile and fixed oils. Water at the freezing point will dissolve 130 volumes of the gas; at 75° F. it will dissolve but 60 volumes. A pressure of fifty atmospheres (45° F.), reduces it to a colorless liquid which, however, again returns to a gaseous state when the pressure is removed. It can be frozen into a transparent solid at a temperature of −150° F. A mixture of this gas and carbonic disulphide when exposed to evaporation *in vacuo* produces the very low temperature of −220° F. The gas is neutral in reaction. It supports combination almost as well as oxygen. A charcoal ember, a piece of phosphorus or burning sulphur will burn with great brilliancy in the gas.

Nitrogen monoxide is best known as an anæsthetic. Its anæsthetic properties were first noticed by Sir Humphrey Davy while he was assisting Dr. Beddoes at his Pneumatic Institute, of which we spoke in a previous chapter. It is used extensively by dentists to abolish sensibility for the purpose of extracting teeth. The anæsthesia which it induces differs from that caused by chloroform, ether, and other anæsthetics; its action is rapid, of short duration and without a stage of excitement. Thesensation is usually one of agreeable intoxication, and is not followed by any disagreeable after effects.

Most writers on the subject, and among them Professor Lyman, hold that the anæsthesia produced by the nitrous oxide is in reality a narcosis, and that it is incapable of furnishing oxygen to the system; there are others who maintain that there is no foundation for such a theory. It is certainly true that many symptoms which always appear in poisoning by carbonic acid and other asphyxiants are not found in cases of poisoning by nitrous oxide; it is difficult, too, to explain many of the symptoms which occurr during inhalations of nitrous oxide, and of the results which follow its use in this way upon any other ground than that it furnishes oxygen to the blood.

Dr. Wallian says, upon this point:

Dr. Ziegler long ago insisted that this gas, being almost as good a supporter of combustion as pure oxygen, is capable, when inhaled into the lungs, of supplying oxygen to the animal system. My clinical experience with it certainly corroborates this estimate.

If it were, in fact, an asphyxiating agent, as so loosely taught, it is evident that its exhibition in unstinted quantities to literally hundreds of thousands of dental patients every year, would be far more frequently attended by disastrous sequelæ. As it is, the danger of a fatal result, even after the most careless and excessive exhibition of it in dental practice, to patients representing every possible degree of vital stamina, is immeasurably less than that represented by the buncome lightning risk appended to some forms of fire insurance policies. It is practically *nil*, since an equal number of deaths would occur in the same practice from nervous shock, accidental anomalies—almost from old age! . . . .

Of the millions of instances of its inhalation, even to its complete saturation of the system, for dental and surgical purposes, how many have proved fatal, or even temporarily injurious? Surely, not so many as have dropped dead while passing along the street, or sitting at table, or as have been smitten by lightning during the same time.

Can such a record attach to so potent an asphyxiator as Prof. Squibb would have us think is found in gaseous nitrogen monoxide. (Medical Record, Oct. 31, 1885.)

The following letter published by Prof. Lyman, in his work on anæsthetics, may be of interest in this connection.

COLTON DENTAL ASSOCIATION,
19 Cooper Institute, NEW YORK, March 14, 1881.

PROF. HENRY LYMAN:

DEAR SIR—We commenced the use of the nitrous oxide gas on the 15th of July, 1863, and on the 14th of the following February we began to take the autograph signatures of all our patients, on a scroll, numbering them on the margin. The present scroll number is one hundred and twenty-one thousand seven hundred and nine (121,709). We have never had a fatal case or a case of serious ill-effects from the gas.

Very respectfully,
G. Q. COLTON.

The following quotation gives a proper estimate to nitrous oxide, and the opinion expressed as to its action coincides with that of the writers:

The mode in which nitrous oxide acts has been variously explained, and while it remains as difficult as ever to understand its soporific and anæsthetic power, it is very easy to refute the principal error in regard to it; which is that it is merely an asphyxiating agent whose action consists in excluding the atmosphere from the lungs. This simple but very absurd hypothesis would liken the presence of the gas in the air-passages to that of a foreign body, or, more precisely, to that of an unirritating but irrespirable gas. But carbonic acid is such a gas, and, although it may prove fatal, it does not produce the discoloration of the skin which is characteristic of nitrous oxide. Besides, nitrous oxide is not irrespirable. The experiments of Zimmerman show that rabbits and pigeons may be confined in it not only for minutes but for hours, and yet return to active life. It must not be forgotten that it not only contains oxygen, but a far larger proportion of it than exists in atmospheric air: and that very possibly a portion of the gas is decomposed, furnishing an amount of oxygen sufficient to maintain life, while the bulk of it remains unchanged and induces cyanosis, unconsciousness and anæsthesia. This conjecture is not a mere hypothesis, for it is established, by experiment, that venous blood introduced into an atmosphere of nitrous oxide assumes an arterial color: and that phosphorus undergoes oxydation in it: that seeds germinate and grow in it: and above all, that it does not put out the light of a burning taper. Finally, a most important, and, indeed, capital fact is that in the series of phenomena which it produces in animals immersed in it, the organ which remains longest in action is the heart: and as the gas is very rapidly eliminated from the system, the brain and the lungs are soon relieved from its influence, while the heart continues to pulsate, and repair whatever temporary damage may have been produced. (National Dispensatory.)

The idea of administering nitrous oxide at an increased pressure and mixing it with oxygen, or air, was first suggested by Prof. Paul Bert, of Paris, France. In a paper read before the Academy of Sciences, Nov. 11, 1878, he says:

The fact that nitrous oxide must be administered in a state of purity signifies that in order to impregnate the organism with a sufficient quantity of this gas, its tension must be equal to the pressure of a single atmosphere. Under the normal atmospheric pressure, in order to obtain this result, the gas must form one hundred percent of the air that is breathed. But, if we suppose the patient placed in an apparatus where the pressure can be raised to the equivalent of two atmospheres, the necessary tension will be secured by respiration of a gaseous mixture containing fifty per cent of nitrous oxide, and fifty per cent of atmospheric air. Under these conditions, there should be manifested a species of anæsthesia while, as a consequence of the presence of the normal quantity of oxygen in the blood, all the natural conditions of respiration are maintained. (Lyman.)

Dr. Fontaine devised a portable apparatus which was conveyed to Saint Louis, Lariboisière, and other hospitals, where numerous operations were performed during the year 1869. Among those mentioned are—"Three amputations of the breast, four operations upon the bones, six extirpations of different varieties of tumor, a resection of the infra-orbital nerve, and two reductions of shoulder dislocations of three or four days standing. The duration of anæsthesia varied from four to twenty-

LANE LIBRARY

six minutes. Complete anæsthesia supervened without any preliminary excitement after a period of inhalation that varied from fifteen seconds to two minutes. Consciousness always returned within half a minute or a minute after the cessation of inhalation. There was neither vomiting nor any subsequent disagreeable feeling in this respect. The anæsthesia produced by nitrous oxide is decidedly superior to the effects of ether or ot chloroform.

Rottenstein, however, records a case in which vomiting occurred after the patient has been kept for thirty minutes under the influence of the gas. The patient had eaten heartily just before inhalation. (Ibid.)

The cumbersome apparatus required for producing anæsthesia after the manner described has prevented its general adoption, and later experiments seem to indicate that results almost equally good can be obtained by administering the mixed gases without any increase of pressure.

Dr. S. Klikowitsch, of Prof. Botkins clinic, in St. Petersburgh, obtained excellent results with a mixture of nitrous oxide and oxygen, in the proportion of eighty to twenty without any increase of atmospheric pressure.

Sir Humphrey Davy, himself, inhaled the gas several times a day for weeks at a time with great benefit to his health. Dr. Beddoes was perhaps the first physician to employ this gas as a remedy in disease. He used it with some success in cases of paralysis.

"Riadore (On the Remedial Influences of Oxygen, Nitrous Oxide, etc., London, 1853) employed it with success in a number of cases, principally affecting the nervous system."

Surgeon Geo. G. Shumman, United States Volunteers, has reported (Am. Med. Times, pp. 28 and 38) a number of cases (14) of typhoid fever, also two of measles and one of erysipelas, in which inhalations of nitrous oxide gas were administered at the stage of prostration for the purpose of supplying oxygen to the system, with beneficial results in all cases; even in some which proved fatal, for life had been apparently prolonged many hours by its means, although insufficient to stimulate to the point of recuperation. Some of these cases which recovered had been pronounced hopeless, and all the patients are reported as having expressed themselves as feeling much the better for the inhalations Attention is called to the resort to this method in the prostrated stages of cholera and other affections. (Cohen on Inhalations.)

Cohen, in commenting on this case, says:

Whether it acts by supplying oxygen is an open question. Other compounds of oxygen and nitrogen, containing a much larger proportion of oxygen, are, as is well known, extremely deleterious when inhaled. It is quite probable that the nitrous oxide has an influence of its own; because, we know that the action of chemical compounds is often different to what might be inferred from a knowledge of the effects of their constituents.

"Quite recently Klikowitsch has used a mixture of nitrous oxide with oxygen for inhalation in the proportion of four to one, and has observed in several cases of angina pectoris (insufficiency of semi-lunar valves), after five or ten inhalations the paroxysms were considerably shortened and relieved. In bronchial asthma, also, inhalations of nitrous oxide reduced the frequency of respirations and increased the depth of inspirations.

In a case of aortic aneurism, with distressing paroxysms of coughing which sometimes lasted uninterruptedly for an hour, the cough ceased during the inhalations and only returned very slightly in the course of the next five minutes of the suspension. A mixture of one part nitrous oxide with three of oxygen produced a favorable influence upon the regulations of the cardiac movement; the pulse came down in this case from 120 beats in the minute to 100, became fuller and stronger, and the urinary secretions increased at the same time.

In two phthisical cases the inhalations composed one patient and diminished the cough in the other; in this case the influence lasted several hours. In many instances, where oxygen inhalations, as such, has no alleviating effect, or very little, inhalations of nitrous oxide acted more favorably without producing a feeling of dryness in the throat; in no case did he observe any harm from its use." (Ziemssen's Hand Book of General Therapeutics; vol. III., Respiratory Therapeutics.)

" Lastly, the record of experiments lie before us, which have been carried out with favorable results by Blake and Hamilton with nitrous oxide, in neurasthemia, headache, sleeplessness; so also in cases of spinal irritation, nervous exhaustion, hysteria, without apparent uterine disorder, melancholia, and delirium tremens. The gas had a very similar effect to alcoholic stimulants without the subsequent depression. According to both authorities the use of this gas is contra-indicated in sthenic affections, but chiefly in conditions which are connected with cerebral congestion, among which the hyperæmia of the plethoric are to be reckoned." (Ibid.)

In 1860, Dr. Geo. J. Ziegler, of Philadelphia, published a small volume in which he claimed great success with nitrous oxide in the treatment of a number of chronic diseases: "Experimenting somewhat extensively his success lead him to assert emphatically that, if properly exhibited in suitable cases, it would be found not only a *materia medica*, but also a valuable *materia alimentaria.* Classing its anæsthetic and anti-spasmodic properties as secondary, he insisted that it served as a *direct cause of supply to the blood and tissues.*"

It is hardly necessary to adduce further testimony as to the therapeutic value of nitrous oxide; the foregoing quotations will suffice to show that it possesses curative properties which are well worthy of more careful study and general application.

It is not our purpose to demonstrate the safety of its anæsthetic properties, nor yet its medical value undiluted and uncombined, it is rather as an ally of oxygen that we wish to commend it.

There are undoubtedly many diseases in which nitrous oxide unaided by other remedies is capable of performing remarkable cures, but its greatest usefulness is as a modifier, an adjunct, and dilutant of oxygen. While it possesses some properties in common with oxygen, it has others not possessed by it, and which adapt it to troubles in which oxygen is not applicable. One of its most characteristic properties is its power over the nerve centers. To a perturbed nervous system its influence is in a high degree tonic and quieting.

It is difficult to explain just how either oxygen or nitrous oxide acts, but from a considerable clinical experience with the gases, both singly and combined, it would seem, that in a general way, each exerts a restraining influence upon the other, checking any excessive action, and at the same time exercising a complemental one; the nitrous oxide bringing to bear attributes not enjoyed by oxygen, and *vice versa.*

We are not able to state who first recommended this combination of gases for therapeutic purposes. Dr. Samuel S. Wallian, of New York, was, however, one of the first to use and recommended it in this country, and he certainly has been its foremost advocate. His cases, reported as early as 1869, have already been referred to. The author has adopted this method, and most of the cases treated and those reported by him, have used the modified mixture of the gases.

Apparatus.

In speaking of the apparatus for generating and administering oxygen, I will not attempt to describe the different designs of the various articles which make up the outfit, but will speak only of such as I have in use.

For the sake of convenience I shall use the term gasometer, as including both the meter-holder or tank and the inverted bell or receiver within it.

For administering the combined gases after the method of Dr. Wallian, at least three gasometers are necessary; one for storing the pure nitrous oxide, another for pure oxygen, and a third for a modified mixture.

It is possible to make one or two gasometers serve the purpose, but it will not be found economy to do so, as such an arrangement will necessitate much extra work, and be a constant source of annoyance. One of the greatest objections to having but one or two gasometers is that a supply of both gases — unmixed — cannot be kept on hand — an almost fatal defect, as emergencies are constantly arising which require one or the other of the pure gases.

In any considerable practice, two additional gasometers for storing mixtures of the gases in different proportions will be found a great convenience.

The gasometers may be made of zinc or galvanized iron; the latter material, on account of its strength and durability, is preferable for the larger sizes. By using large gasometers it will not be necessary to generate so frequently.

To a physician who has not a competent assistant to whom he can entrust the generation of gases and care of apparatus, the size of the gasometers will be found a most important item, as much of his time will be consumed in preparing chemicals, generating and commingling the gases.

For an ordinary practice I would not advise gasometers of less than seventy-five gallons capacity, and where but three are made use of, it would be better to have the one which is used for storing the commingled gases with a capacity of from 100 to 150 gallons.

A convenient proportion for a gasometer of about seventy-five gallons capacity is twenty-five inches diameter and forty-four inches high for the tank or meter holder; the bell receiver being at least one inch less in diameter, in order that it may have ample play, as it rises and falls with the pressure of the gas, and two inches shorter, so that it may descend until the water completely fills it, thus expelling all the air, and enabling the gas to be entirely driven out when it is to be filled anew or to be used for a different gas.

The tank is filled with pure water to within an inch or two of the top, and should have a faucet soldered into one side near the bottom to facilitate the drawing off of water when this becomes necessary.

The smaller ones should have two, and the larger ones three, broad bands encircling them, to give strength and solidity.

In the top of the inverted bell should be openings for the ingress and egress of gases. Where three gasometers are used — and the one for commingled gases can be placed between the other two — the end ones should have three openings with stop-cocks to each, as follows: one for permanent connection with piping which conducts gas from wash-bottles, one for permanent connection with the center gasometer and one to which is attached a rubber tube with mouth-piece for administering from gasometer. The center one has four openings, two for permanent connection with gasometers on either side, one to connect with piping which may lead to consultation-room or other apartment, and one for administering directly from the gasometer.

If the gas is conveyed into another apartment, the piping which conducts it should start from a point two or three feet above the center gasometer — presupposing the gasometer to be near the wall — and have attached to its extremity a long piece of rubber tubing so that it can be connected with either of the end gasometers or the center one.

The gasometers should stand on a platform about ten inches high, so that an ordinary water bucket can be placed under the faucet when it is necessary to change the water.

This platform should be securely made and capable of supporting considerable weight, as the gasometers when filled with water are quite heavy.

If a frame-work is used to suspend and balance the bell, iron loops should be soldered on opposite sides for attaching ropes. If the bell is suspended by means of pulleys fastened to the ceiling, a strong loop or eye should be soldered in apex of bell.

The weights used should be about the same as the weight of the inverted bell.

The weight for the large gasometer — or the one which is used for storing the commingled gases — need not be as heavy, relatively, as the others, as this is used only for commingling the gases after they are generated, and not for receiving them directly while generating.

In the case of the others unless the bell is well balanced by the weight, the pressure of the gas required to raise it would be sufficient to force the stoppers from the wash-bottles.

An approximate scale in cubic inches may be arranged upon the framework or upon the bell itself, for the purpose of estimating the volume of gas generated, commingled or administered. When more than three gasometers are desired, the extra ones may be smaller, as they will not be required so often, the majority of patients using the standard mixture from the larger gasometer.

For the sake of appearance and durability, the tank, top of receivers and platform may be painted a uniform color or ornamented as fancy dictates.

For conducting the gas from wash-bottles to receivers, either rubber tubing or gas piping may be used. I prefer to use the galvanized iron piping, and when it is desired to administer the gas in another apartment the galvanized piping may also be utilized. When putting up piping the plumber should be instructed to use no red lead in tightening the joints, as it will cause the gas to taste. Sweet oil will serve the purpose, and cause no objectionable taste. This arrangement will afford an opportunity of administering to two patients at once. This is rendered feasible by the manner of giving, as a treatment consists of single, or rarely two, inspirations, with an interval of from five to fifteen minutes, thus it will be seen the operator may divide his time to advantage between two patients and without the necessity of bringing them in contact.

In generating either of the gases a series of from four to six wash-bottles are used, the size of which will vary from one-half to one gallon. I find the latter size preferable. The bottles should be of rather thick glass, having a strong neck, the opening of which is not less than two inches in diameter, each bottle is fitted with a thick rubber cork having two half-inch perforations into which are fitted bent glass tubes, a long one reaching to within an inch of the bottom the other penetrating just beyond the cork. When in use the wash-bottles are connected by short pieces of rubber tubing which are slipped over the end of the long tube of one bottle and the short tube of the other. The first bottle is connected in a similar manner with the tube from the retort, and the last one to the piping which extends to gasometer, thereby giving a continuous connection between the retort and gasometer.

One series of wash-bottles can be made to serve for both gases, though in many respects it will be found more convenient to have a series for each gas, in which case, if it is desired, both may be generated at once.

In making the nitrogen monoxide a glass flask or porcelain-lined iron retort may be used. The danger of breakage is greater where a glass flask is employed, but it possesses the advantage of enabling the operator to observe the action of the chemicals and regulate the heat accordingly. Any tendency to the formation of the objectionable acid vapor may be at once detected, and by promptly decreasing the heat prevent its being driven over and absorbed by water in the wash-bottles.

For an outfit such as I have been considering the flask should be what is called the half-gallon size. This is fitted with a rubber cork having a single perforation into which is inserted the short end of one of the long glass tubes.

As little rubber tubing as possible should be used in making connection between flask and first wash-bottle, as the acid vapor which condenses in the tube very soon renders the rubber unfit for use.

For generating oxygen a copper retort not smaller than one quart is used.

I now use a half gallon retort even when generating a small quantity of gas, as less of the chemical is driven over when the gas is being rapidly evolved.

The chemicals, while heating, harden or cake some, and then when a rapid evolution of the gas commences hard masses may be detached, forced into the outlet, and so wedged there as to partially or wholly occlude it. Should such an occurrence take place an explosion would result. The danger of such an accident will be greatly lessened by using a large retort, which need not be more than one-third, or at least one-half filled with the chemicals. The outlet of the retort must be large enough to allow free escape of the gas. For a half gallon retort it should not be smaller than half an inch, and even larger would be better.

The retort should be made with a projecting lip at the opening, the upper surface of which is ground to fit a corresponding lip or flange upon a tube several inches long. When in use the tube is firmly secured to the flask by means of a metal clamp and set-screw.

Heat may be furnished by an alcohol lamp, oil or gas stove. If an alcohol lamp is used it should be one with a wick which may be turned up and down to regulate the heat.

The gas stove will be found the most convenient and economical where gas is available. When this is used the ordinary one-burner gas stove will serve the purpose.

To condense and at the same time equalize the heat around the flask I have had a sheet-iron cylinder made four or five inches high and just large enough to fit inside the rim of the stove and resting upon the arms which support the burner. In this cylinder, about two inches above the burner, is riveted a piece of perforated tin or wire gauze, or better still, a piece of perforated sheet iron; this serves to spread the flame and also, in case of an accident, prevents the chemical from running down on to the flame. Less heat will be wasted, and the process of generation facilitated, by having a funnel-shaped tin made, the small end of which fits around the retort about two inches from the top, and the other end large enough to fit over the top of the drum when the retort is suspended in position; this must, of course, be put on before the tube is clamped to the retort.

The glass flask or copper retort, when in position for generating, should be suspended over the stove so that the bottom hangs an inch or two down into the cylinder.

To prevent bespattering the shelf and surroundings with heated or burning chemicals, should the flask break or explode, I have a raised border on that portion of the shelf where the stove stands, which is lined with tin. Where the shelf is against the wall it should also be protected with tin or zinc.

This completes the list of apparatus for generating and storing the gases. But to facilitate the commingling and dilution, a pump and reservoir for compressing air will be needed. This is not indispensable, but is a great convenience, as it insures a more thorough mixing of the gases, and greatly expedites the whole process.

The nitrogen monoxide and oxygen being of different specific gravity do not readily commingle when put into the gasometer without pressure; they would eventually become mixed without pressure, according to the well-known law of diffusion of gases, but this would only take place very gradually.

As the gases are not only to be commingled, but also diluted with atmospheric air, both of these objects may be simultaneously accomplished by compressing air in the reservior to about twenty pounds pressure and, by means of a rubber connecting tube, allowing the desired quantity to pass into the gasometer under this pressure. To avoid the necessity of frequent pumping I use a large reservoir — the ordinary hot-water reservoir, either copper or galvanized iron, may be utilized for this purpose, providing the usual outlets are plugged sufficiently tight to resist the pressure.

The reservoir should be fitted with a low pressure steam gauge, so the exact pressure may be determined.

An inhaling bottle or bottles, with a few mouth-pieces, will complete the apparatus for generating, storing, commingling and administering the gases.

The mouth-pieces may be of hard rubber or glass. A very good plain mouth-piece may be made from what is known as steam-gauge tubing, which can be obtained from any plumber or gas-fitter. This glass tube comes in sufficient length to make two mouth-pieces by cutting it in the middle. In this manner each regular patient may be furnished with a mouth-piece and labeled with his name or number.

The gas may be given with or without an inhaling bottle. For this purpose a small wash-bottle may be employed. A quart decanter or an amberina water bottle will serve the purpose and at the same time be ornamental. Something of this kind is especially desirable where gas is administered in the consultation room. These bottles can be found at any china store to fit the rubber corks, such as are used for the wash-bottles — the two perforations being necessary, same as in the regular wash-bottles. The inhaling bottles are filled about half full of water through which the gas is drawn, in large, bright bubbles. The water may be medicated if it is thought desirable.

Dr. Wallian, of New York, suggests an oxygen cabinet, which shall contain four gasometers, wash-bottles, flasks and other necessary articles. This appears to be an excellent plan, but to contain gasometers sufficiently large to hold any considerable quantity of gas the cabinet might be of a size which would render it objectionable, especially to such as are limited as to room.

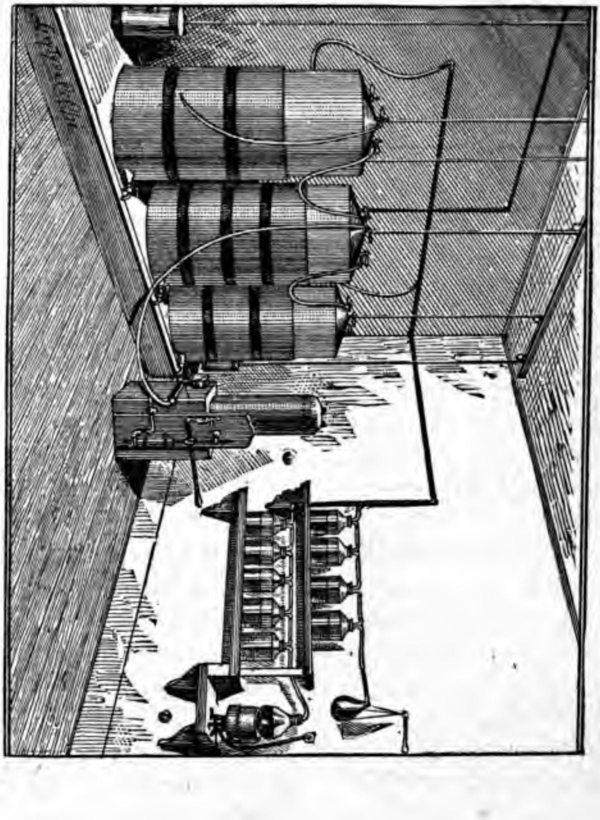
According to estimates of my own, a cabinet of sufficient size for four fifty-gallon gasometers would have somewhere near the following dimensions: ten feet long, two feet deep and seven feet high. The general design may be made to suit the owner. A manufacturer of oxygen outfits in this city has perfected plans for a similar cabinet.

With reference to getting up the apparatus such as I have described, some will doubtless not care to expend time and trouble in planning it for themselves, and in many respects it is certainly more satisfactory to purchase the complete outfit from a regular manufacturer or dealer and have it delivered entire, with instructions for putting it in working order. This will, most likely, insure perfect adjustment and more secure connections than would be the case where the various articles must be ordered by description from different places.

Compressed Oxygen and Nitrogen Monoxide.

Both the oxygen and nitrogen monoxide can now be obtained in the large cities compressed in cylinders. This ready and effective mode of administering the gases will doubtless ere long come more into vogue in localities where it can be procured.

Doubtless many physicians will avail themselves of this convenient way of keeping and administering the gases who would never go to the trouble and expense of putting in the apparatus.



Another consideration in favor of the compressed gas is the limited space occupied by the cylinders.

Every physician, with however little room at his command, can find space for one or two of them, while even a small oxygen outfit will require more room than many can afford to give it without enlarging their quarters.

The fact that the cylinders are portable is also a great advantage, as a large class of patients will only be able to take the gas at their own homes, and must have it conveyed to them in some form. Small quantities, for instance, enough for a day's treatment, can be transported in rubber gas-bags, but with this manner of transportation fresh gas must be procured each day, and if for any reason a larger supply is required, much annoyance would result. Cases of poisoning, or severe dyspnœa from asthma, cardiac disease, obstructed respiration of diphtheria or croup, convulsions, etc., would necessitate a large quantity and continuous supply, which could not in any way be so conveniently had as by means of the cylinders of compressed gas.

The gases can be compressed in any desired proportion, either pure or diluted with atmospheric air. For instance, I employ, more than any other, a mixture consisting of oxygen, one volume; nitrogen monoxide, one volume; common air, two volumes. Cylinders could be obtained with the gases compressed in exactly this proportion, or the two could be mixed in equal proportions, air being added at the time of administration. When administering the compressed gas either a rubber gas-bag or small gasometer—which need be little if any larger than the ordinary spirometer — is employed, in the same manner in which the dentists use it when giving the compressed nitrogen monoxide for anæsthetic purposes. The gas being allowed to escape from the cylinder into the gas-bag or gasometer is then inhaled through a rubber tube and mouth-piece provided for the purpose. The gas may be kept for any length of time in the cylinders without wasting or losing strength, something which can hardly be said of it when stored for a long while in the ordinary gasometer.

The cost of the compressed gas, though perhaps not unreasonably high, is still more than double that of generating it. Many, too, will find it a satisfaction to have the gas made under their own supervision, thus leaving no doubt as to the quality of the chemicals used and thoroughness with which the gas is purified.

The cylinders being quite expensive, manufacturers will not take the risk of sending the gas to a distance, unless the purchaser buys the cylinders. This fact, together with the cost of transportation, necessarily—for the present—confines the use of compressed gas to the larger cities and their immediate surroundings.

Of the comparative merits of the two methods — when both are at command — it is difficult to speak, since each has advantages peculiar to itself, and it will depend upon the practice, location and personal views of the purchaser as to which will the better suit his purposes. In large cities, probably the majority who use the gas will employ the compressed product, it being less troublesome and requiring but little room, although even here not a few will prefer to have their own apparatus.

PART II.

CLINICAL CASES ILLUSTRATING THE USE OF OXYGEN AND NITROGEN MONOXIDE.

Diseases of the Respiratory Organs.

ASTHMA.—Miss A. B—, nineteen years of age. Family history good except that her mother died young. Father, Judge ——, quite robust at sixty-eight. She has suffered from spasmodic asthma since childhood, the paroxysms occurring daily, and on the slightest exposure. She is very delicate, anæmic and fatigued on slight exertion. Has constant dyspnœa and marked cyanotic appearance,. Appetite weak and capricious.

May 25th.—Patient placed on ℞. Oxygen, 1 volume nitrogen monoxide, 4 volumes; of which she inhales five; gallons daily, with the result of immediately relieving the dyspnœa. Her lung capacity is but seventy-five cubic inches.

June 4th.—Improvement has been steady. No more cyanosis; does not suffer from paroxysms; appetite fairly good. She inflates her lungs much better than at first; capacity one hundred cubic inches.

June 20th.—Proportion of oxygen increased to forty per cent. No return of paroxysms. General health greatly improved.

July 1st.—General improvement continues. From being caught in a storm has had one mild asthmatic paroxysm.

July 10th.—Patient can now endure active exercise without fatigue. Treatment continued every other day. Inspires one hundred and forty cubic inches.

July 25th.—Treatment has been irregular since last record, but patient's general health continues to improve; breathes, sleeps and eats well. Exposes herself to changes of weather and temperature with impunity.

August 10th.—There has been no recurrence of the asthma, although patient asserts that she has repeatedly exposed herself to the same influences which invariably induced paroxysms previous to treatment. She is advised to continue the treatment at intervals, but as the family are about to remove from the city no further observations are practicable.

November 30th.—This patient writes that she continues to enjoy excellent health, and has had but one asthmatic paroxysm since leaving the city—this from being drenched to the skin in a sudden rain storm. (Dr. Wallian, in Medical Record.)

Mr. L., aged sixty-two. Has been a sufferer from asthma and bronchial catarrh for ten or twelve years. The first approach of cold weather has always been a signal for the onset of severe asthmatic symptoms, which not only rendered business burdensome but at times an impossibility. Often paroxysms so severe that he was obliged to spend the night in the easy chair owing to the distress occasioned by a recumbent posture. He began the use of oxygen in January while suffering from a severe attack. He was put upon the modified mixture, two small treatments daily. Pure oxygen was given during the severe paroxysm with the effect of removing the most distressing symptoms at once. Dyspnœa and cough improved from the first, so that at the end of three weeks but one small treatment—of four inhalations—daily, was given. This was continued for a month longer. After the first week there was no return of the distressing symptoms and a decided improvement of the bronchial trouble was manifest. This gentleman remarked incidentally that his bowels had not acted so regularly for years as since commencing the oxygen treatment.

Phillip's (Mat. Med. and Ther.) relates the following: Dr. John Hooper thus describes its effect in a man of fifty-two, "for many years a martyr to asthma." During a very severe paroxysm he was thought to be dying, it seemed impossible that he could rally. As a *a dernier ressort* oxygen was tried, the end of a glass retort containing it being applied to his mouth, though he had no power to enclose it with his lips. "The effect was wonderful and quickly manifest, in increased mobility of the ribs, fuller inspiration, disappearance of lividity, and lastly in his seizing the end of the retort and in the avidity with which he inhaled when possessing the voluntary power." (British Medical Journal, i., 1862.)

Mrs. C., aged sixty; widow, had asthma complicated with emphysema for thirteen years. During the winter, her sufferings from asthmatic attacks rendered life a burden. Would pass her nights propped up in a chair for weeks at a time. When at her best had severe dyspnœa when attempting to walk any distance or ascend the stairs. During her worst attacks the stomach became so irritable that it would scarcely tolerate any food, at times even water could not be retained. Sleep always disturbed by coughing so that she rarely succeeded in getting sufficient rest at night. Being unable to come to the office the gas was sent to her in a rubber gas-bag, the modified mixture O,N_2O, and common air, *aa*, one gallon, b. i. d. At the end of a week the patient was much improved, the quantity of gas was now increased to two gallons, b. i. d., this was gradually increased until she took six gallons a day, the patient reporting continued improvement. After the third week she often slept through the whole night without coughing, and this, too, in bed instead of in her chair as formerly. Can walk about the house and even up stairs with but little dyspnœa. Appetite excellent, can eat most anything with impunity. The gas was continued for two months with the effect of removing almost every trace of asthma. She was emphatic in her praise of the oxygen, declaring that she had not enjoyed such freedom from asthma in ten years, and that the gas was the only thing that benefited her.

Beddoes related twenty-two cases of which he claimed to have cured ten, and relieved nine; and it seems worth while to refer to his case of "Mr. Hare, of Conduit street, who in 1796, after having been subject for eleven years to asthmatic attacks accompanied by indescribable suffering, and only relieved after many hours of blisters and expectorants" recovered average health under the use of the gas continued for some months. M. de Marquay also witnessed excellent results, *e. g.*, in a man aged nineteen, subject from childhood to asthmatic attacks; "they ceased, as if by magic, as soon as he began to inhale oxygen." ("Essai de Pneumatologie," p. 725.) (Phillips' Mat. Med. and Ther.)

The case of the late Secretary Stanton presents an instance in which oxygen was the means of averting a great deal of suffering. He was subject to severe paroxysms of asthma, which, during his last illness, constituted a serious aggravation of his condition. His medical attendant, Surgeon-General Barnes, of the United States Army, procured from New York a supply of compressed oxygen, of which from three to four cubic feet were inhaled daily. It controlled the paroxysms completely, and, so far as the asthma was concerned, met every indication. In a recent conversation with me General Barnes expressed himself warmly in favor of the gas in similar cases, and stated that both he and his illustrious patient were entirely satisfied with its effects.

I have myself administered oxygen in several cases during the paroxysm, with the effect of causing almost instant relief; but, as it was not continued during the intervals, no permanent benefit was experienced.

It will be observed that three of the cases reported by Beddoes received no benefit whatever. I have also had a similar experience. A clergyman, subject for many years to infrequent but prolonged attacks of asthma which had completely baffled all previous treatment, was seen by me at the onset of a paroxysm. The respiratory movements were very rapid and extremely energetic and the dyspnœa considerable. Still there was no evidence whatever of imperfect æration of the blood. The countenance was flushed, but not in the slightest degree dusky. Oxygen was administered very freely, about four gallons every half hour, but with no appreciable relief to the dyspnœa. (Smith's Essay).

BRONCHITIS.—E. W., aged forty-nine; insurance agent—one of the toughest of his kind! Could talk a graven image into taking a policy, if he had time. Mixes his family history so much with Farr's tables, and the "actuary's experience" that I cannot make much of it. Is suffering from a "chronic cold on his lungs" which I diagnose as bronchitis—subacute, with some pulmonary congestion. Has a very harassing cough; is quite dyspeptic; constipated bowels, harsh, dry skin, haggard appearance.

April 8th.—Placed him on the use daily of the standard admixture of equal volumes of O,N_2O, and common air. Lung capacity 150 cubic inches. Urine heavy with chlorides, etc.

April 10th.—Decidedly relieved; coughs less; raises more easily; sleeps and eats better. Treatment continued, increasing the proportion of O. Lung capacity 180 cubic inches.

April 25th.—Patient says he is pretty much "cured," and that the treatment has benefited his general health more than all the tonics, bitters and "blood renewers" he has ever taken. Has a more natural appetite than for twenty years and ***is quite relieved of his habitual constipation.***

May 8th.—Reports himself "well." No cough, respiration free and natural, all bodily functions well performed.

Saw this patint six months later; no relapse. (Dr. Wallian in Medical Record.)

Miss E. A. W., aged thirty-one, superintendent of a fur manufactory, the confinement and dust of which is very irritating. Strumous habit, but family history negative. Is anæmic, despondent, and complains of a constant cough; areas of dullness over right lung, with persistent bronchial irritation and bronchial catarrh.

April 20.—Placed this patient on a mixture of O,N_2O, and common air. Lung capacity, 130 cubic inches, although a woman of more than average stature and weight. Advised daily exercise in the open air and nutritious diet.

April 30th.—No apparent improvement; cough rather worse; expectoration very profuse, and sputa containing fetid, cheesy (tubercular?) matter. Treatment continued.

May 10th.—Appetite rather better, and sleeps more regularly; otherwise no visible improvement. Cannot secure out-door exercise to any extent. Treatment changed to O two volumes, N_2O and atmospheric air *aa* one volume. Lung capacity, 150 cubic inches.

May 20.— Lung begins to clear up, but no outward sign of improvement. Patient much discouraged, and only consents to continue the treatment on my positive assurance that she has made some progress. Lung capacity, 160 cubic inches.

May 30th.— Now reports her general health as very decidedly improved; cough perceptibly better her former sallow ("bilious") complexion has cleared up, and is now fairly ruddy. Eats and sleeps well, and enjoys a buoyancy of spirits unknown for years.

June 10th.—Reports herself "cured," and is loud in her praise of the treatment. Says she had no faith in it in the start. Her cough is almost entirely gone; respiratory murmur audible all over both lungs, and *has gained twenty pounds in flesh.* Lung capacity, 195 cubic inches. Treatment discontinued, patient going to the country for a vacation.

August 8th.— She returns for additional treatment. Took a severe "cold" *en route* from the country, and her bronchial trouble returned. Severe passive congestion of both lungs, annoying cough, with muco-purulent expectoration. Pulse, 94. At the first sitting she inhales two full inspirations of O one volume, N_2O one volume, and common air two volumes. Within five minutes her pulse fell to 84, and the immediate dyspnœa is decidedly relieved.

August 20th.— Some cough yet, but great general improvement is evident. Severe bronchial irritation persists, and, continuing the oxygen treatment, a local spray is added. ℞. Potas. chlor. ʒj. ad. aqua ℥iv.; alternating every other day with ℞ Fl. ext. hyosc. ʒ ss. ad. aqua ℥ viij. per steam atomizer. Complains of pectoral and intercostal myalgia, for which ordered a stimulating lotion and tonic regimen.

August 29th.—Notable improvement is evident. Bronchial difficulty is much relieved; myalgia gone, and not much cough left. Treatment interrupted.

Sept. 20th.—Treatment resumed every other day, improvement having continued since last record.

Oct. 10th.—This patient now considers herself well, but is advised to leave the factory and live more out of doors if possible.

Saw this patient six months later, and although she has not left the unwholesome factory, she continues well.

CAPILLARY BRONCHITIS.—The patient, a child two and a half years old, was at the point of death from bronchitis, intercurrent with measles. The respiration was 80, and accompanied by mucous rales audible at some distance from the bed, pulse too frequent to be counted; face pale and dusky, extremities cold. Within one hour after the continuous administration of oxygen was resorted to the pulse had fallen to about 160, and the respiration to 40. Within another hour the face had regained its color, *and the rales were no longer audible unless the ear were applied to the chest.* The inhalation was continued without interruption for three hours, and irregularly for five hours longer, when it was wholly discontinued. The following day convalescence was fully established. (Dr. A. H. Smith, in Medical Record for June 15, 1869.)

OBSTINATE COUGH, PROBABLY OF REFLEX ORIGIN.—Mrs. W., aged thirty-seven, married, came to me for the relief of an unusually obstinate cough, of between four and five years' standing. Has been under the treatment of a most excellent physician who had studied her case carefully and done every thing in his power for her relief but failed to give more than temporary benefit. Cough was paroxysmal, severe seizures occurring at night which continue uninterruptedly for half to three-quarters of an hour, and are often frequently repeated, thus greatly interfering with and often abolishing sleep. Paroxysms frequently occur while eating, which compel her to retire from the table, and sometimes result in her losing what food she has taken. At times complains of circumscribed soreness in upper part of right lung. Repeated examination of lungs have been made by her physician but always with negative results, nothing of importance being discovered. It was thought that the presence of an hypertrophied tonsil and slight follicular pharyngitis might be the cause, and they were energetically attacked and much relieved, but with no effect upon the cough. The question of "trigeminal cough," "liver cough," "ear cough," "stomach cough," "ovarian," "uterine" and various other coughs were successively canvassed, and duly discarded as untenable. Some good ground existed for considering the cough of gastric origin, since the patient was a great sufferer from atonic dyspepsia accompanied by an unusually torpid state of the bowels, no evacuation occurring sometimes for a week unless enemas were resorted to. All the ordinary and some extraordinary remedies were tried unavailingly, much to the disgust of both patient and doctor. For some time before commencing the use of oxygen the patient had taken no treatment whatever. Hearing of a similar case being cured by oxygen she consulted me, and finally decided to give the oxygen a trial.

The first treatment was followed by a night of perfect rest uninterrupted by a single seizure of coughing, something unknown for over a year. I do not mean to convey the impression that the cough ceased forever, but it did continue to improve steadily. The appetite returned, gastric symptoms disappeared and the constipation was much relieved, though in this case, not cured. The treatment was taken for a month, patient deeming further treatment unnecessary.

CROUP.—Miguel reports a very interesting case of Dr. Beigel's, as follows:

Severe case of croup; application of the usual medicaments without benefit. Immediate alleviation after oxygen had been inhaled. The patient was a boy twenty-one months old, hitherto perfectly healthy. On February 21st, 1862, Miguel was summoned and found the child in the following condition: Breathing, noisy and whistling, short, some fifty respirations in the minute, but irregular as well with respect to the rhythm as to duration; pulse, small, very frequent, impossible to be counted; countenance pale, lips livid; all muscles are active during breathing, and the regular movements of the levatores alæ nasi, of the muscles of the throat, etc., were combined with irregular spasmodic movements, which now and then agitated the face. The little patient frequently bent his head quite backwards, the expression of his countenance being very anxious, and seized his throat convulsively with his hands. His face was moist and cold. The child very seldom yet made efforts to cough; when coughing the voice appeared barking, hoarse, suppressed. According to the report of the house doctor, nine days ago the child was seized with symptoms of croup, which at first decreased by emetics, leeches and other remedies; but three days ago recurred with great intensity. The usual remedies were applied again, but failed to do any good, and a newly administered emetic was to the same effect, involution of the legs in mustard powder, and inhalations of hot steam were vainly resorted to. At half past ten, inhalations of oxygen were tried. One cubic foot of that gas, one volume of pure oxygen mixed with a smaller portion of atmospheric air in a gasometer, was brought to the patient's residence. The amount of respiration might have been about five cubic inches, the quantity of gas (1728 cubic inches) was therefore sufficient for 350 inspirations, which might have been performed in about nine or ten minutes, yet the procedure lasted about fifteen to twenty minutes. The child's condition after the inhalation was the following: pulse perceptible, less frequent, number of respirations about the same. The appearance of the child was, according to the judgment of all persons around him, more quiet, less anxious; patient became more reactive to the impediment to respiration, so that he coughs frequently, though with the peculiar croup sound; once such a cough spontaneously produced vomiting. The spasmodic movements of the muscles of the face, as well as of other regions of the body, ceased, and at one o'clock in the morning the parents came to me to report that the child had slept very quietly, and that the spasm and anxiety had disappeared. They added that on no previous night the suffocating seizures and the expression of the countenance had been so alarming; but that on none of the four previous nights was the patient so quiet as he is to-night. On the following morning the child was found to be still better, and though the oppression recurred on the following evening in a slight degree, yet all the remainder vanished by medicaments applied for the disease itself, and the patient recovered entirely. (Cohen, on Inhalation, Its Therapeutics and Practice.)

Dr. Beigel describes another severe case of croup in which the usual modes of treatment had been exhausted without avail, the respiration being forty per minute and noisy, the pulse too frequent to be counted, lips livid, and face pale and agitated by convulsive movements. The inhalations of one cubic foot of oxygen was followed by decided improvement, and in the course of two or three hours the child fell asleep, awakening convalescent and making a prompt recovery. (Beigel on Inhalations, p. 105.)

Dr. Miguel reports a case with symptoms identical with those above mentioned, which was immediately relieved by the use of oxygen, and ultimately recovered. (Half-Yearly Compendium, Jan., 1869.)

I have been called in to give oxygen in several cases of croup, but always in the last stages, when the long-continued dyspnœa had led to mechanical engorgement of the lungs, and the poisoning of the nerve-centers by the circulation of unaërated blood. Under these circumstances, although I have been able to relieve the dyspnœa in a measure, still death has been the result. The termination in such cases is usually the same when the trachea is opened, even if the respiration is thereby made easy.

It is my firm conviction that oxygen will do in most cases of croup all that could be done by tracheotomy, but neither the one nor the other is competent to undo the mischief wrought by severe and protracted dyspnœa Hence, the practical rule in the use of oxygen is the same as that in the use of the knife—*use it early.* There is nothing painful, nothing horrible, nothing dangerous about it. Why then should it be resorted to only at the last minute, as if it were a more desperate remedy even than tracheotomy? (Dr. A. H. Smith's Essay on Oxygen in Disease.)

DIPHTHERIA.— Beigel relates the details of several cases under his care treated by alternate inhalations of oxygen and of nebulized fluids.

"One of these was advanced diphtheria in a child six years of age, which was cured by the inhalation of oxygen gas, one gallon morning and evening, and the inhalation of a solution of the tincture of the chloride of iron, ten minims to the fluid ounce of water; a remarkable alteration in the patient's condition being perceptible after the first inhalation of oxygen. Also, a very severe case of diphtheria after small-pox, with exudation lining the whole pharynx, laryngeal implication, suffocative paroxysms, etc. The patient, a boy ten years of age, was seen by Dr. Beigel on the fourteenth day of his illness, after the administration of calomel for six days had afforded no relief. This case was treated by inhalations of the spray of hot water, afterwards of lime-water, and subsequently of tanin; oxygen being administered to relieve the suffocative attack with complete success and being continued twice a day as long as requisite, the combined treatment resulting in a cure." (Cohen on Inhalation.)

In one case of diphtheria I was called only when the child was in *articulo mortis.* For four hours life was sustained by the gas which could not be withheld for more than a few minutes at a time without producing suffocation. At the end of that time the parents were informed that the case was hopeless, and it was left for them to continue the gas as long as they saw fit, a supply being prepared beforehand. The inhalation was continued an hour longer and then abandoned. Death took place within five minutes after the gas was withheld.

In this disease, in addition to the impediment to respiration, we have to contend with the septic condition of the blood; tending greatly to depress the power of life. I believe, with Dr. Beigel, that this latter condition may be prevented or remedied more surely by inhalations of oxygen than by any other resource we possess, while, at the same time, the danger of death by apnœa is obviated.

For the removal of the local affection the usual remedies may be simultaneously applied.

"I am permitted to refer, in advance of publication, to a recent case, which I saw with Dr. G. T. Elliot, in which inhalation of oxygen was of great service. The patient, a child two and a half years old, presented well marked diphtheritic croup. The dyspnœa, which was very decided, was greatly relieved by the gas, and it was Dr. E's opinion, as well as that of other gentlemen who saw the case, that the oxygen also aided materially in overcoming the tendency to death by asthenia, and that without it a fatal termination would have been inevitable. The inhalation was kept up almost continuously for a week; the last three days only as a tonic, the tendency to asphyxia having ceased on the fourth day." (Second Ed., Dr. A. H. Smith.)

A girl, three years of age, had diphtheria with a scarlatinoid eruption; pulse too rapid to be counted, but seemed about two hundred Oxygen was administered, and in twenty-four hours the eruption had entirely disappeared, and the pulse had fallen to one hundred and twenty. The fourth day the child sat up and ate. No other treatment except local. "The recovery was so unexpectedly rapid that I am inclined to believe that, after all, the child was not so dangerously ill; and it was, perhaps, only her peculiarity to be overwhelmed by fever at any commencing sickness. It was the first time I had seen the child.

Case of diphtheritic scarlatina, angina alarming, delirium. Each inhalation of the gas caused the delirium to give way at once to sleep. Thirty gallons of oxygen were given per day, for the first four or five days; the quantity was then reduced to nine gallons, and continued for four or five weeks as a tonic. No other treatment except concentrated nourishment and the local use of chlorate of potash and carbolic acid. (Extract of letter to Dr. Smith from Dr. G. Frauenstein.)

PULMONARY EMPHYSEMA.—Dr. Beigel reports a case in which the shortness of breath was so great as to prevent the patient walking more than a few steps at a time. By inhalations of oxygen, one gallon every three hours, a prompt amelioration was brought about, and at the end of six weeks the distressing symptoms had nearly disappeared. During this time there was no other treatment than inhalations once or twice day of solution of common salt, (two gr. to the oz.) for twelve days, after which "pulverized," pure water was substituted. Subsequent to this time a solution of tannin and morphia was used in connection with the oxygen, and in less than two months from the commencement of the treatment the patient was able to return to his business, though he could not dispense with the oxygen for more than a few days at a time without a return of dyspnœa.

Two months later the unnatural prominence of one side of the chest, which previously existed, had sensibly diminished, the area of tympanitic sound was much decreased, and the amount of respiration had increased from 2.150 to 3.200 cubic centimetres. (Beigel on Inhalations, p. 143).

In this case it is evident that something more was accomplished than mere present relief of the dyspnœa. A radical improvement in the disease itself was effected. This was perhaps due to the diminished force of the respiratory movements, and the consequent lessening of the strain upon the delicate tissues of the air-cells, resulting from the relief to the dyspnœa.

A case is reported by myself in the May number of New York Medical Journal, 1869, in which the gas was given, but only for a short time. The dyspnœa was greatly relieved, the countenance lost its livid hue, the pulse fell from 122 to 100, and the respiration from 36 to 20.

The relief continued but a short time after the oxygen was discontinued, but was again experienced when in use was resumed. (Smith's Essay.)

The following case was published in the Practitioner, vol. 2, May, 1869, by Dr. Mackey:

A lady, aged fifty-five, was subject to constant dyspnœa, increased by every movement, and amounting, at times, to partial asphyxia. She had had the physical signs of the malady, together with dilated weak heart and embarrassed circulation, as evidenced by œdema of of the face and extremities; was subject to attacks of bronchitis, but at the time of treatment the main complaint was the difficulty of breathing. She inhaled a mixture of from three to twelve pints of oxygen, with sixty of air, at intervals of three or four days, for a period of six weeks. After each dose marked relief was experienced, which she expressed as being able to take a deep breath and get sufficient air (a feeling not known for years), as being able to move with comparative ease, feeling more buoyant and more like healthy persons should feel, than she ever remembered." Expectoration was rendered more copious and facile for a day or two after the inhalation; there was no other definite effect on secretion, nor any on circulation, unless it were some palpitation during the night after a large dose. The nervous irritable states to which such patients are liable were also soothed under the treatment, which certainly affected more than ordinary medicinal agents. It could not, however, alter the organic conditions, and cardiac death occurred suddenly, after an attack of bronchitis, in the following winter. (Phillips' Mat. Med. and Thera.)

PNEUMONIA.—Dr. E. G. Janeway, in addressing the New York State Medical Association, said that oxygen gas was of great value in pneumonia if given at the very commencement of cyanosis, but if begun later, after cyanosis was fully established, it was less useful, and that it should be repeated as often as the blueness of the skin reappeared. (Medical Record, Nov., 1885.)

Mr. C., aged thirty-three, married, an engraver. One year ago last winter, he suffered a severe attack of double pneumonia; perfect resolution did not result, indurations remaining in both lungs; he also continued to have a troublesome cough and dyspnœa. Lung capacity on commencing treatment was 154 cubic inches. In two weeks it had increased to 175, and both cough and dyspnœa were much diminished. Patient took the treatment a month, at the end of this time he thought his lungs as good as ever, chest capacity in the meantime having increased to 210 cubic inches. The indurated areas had almost cleared up, only a very slight dullness remaining.

(Six months later this patient has continued to improve, cough and other lung symptoms have ceased to trouble him.)

" Dr. Golden reports, in the Lancet for March 10, 1866, a case of double pneumonia accompanied by great dyspnœa, which resolved in four days under the use of oxygen.

" I have seen a case in which circumscribed pleuro-pneumonia occurred in the course of chronic pyæmia was apparently aborted within thirty-six hours by the use of gas.

" Dr. Frauenstein has furnished me with notes of a case of pneumonia, in a child of two years of age, involving the lower half of the left lung. The disease was ushered in by convulsions so persistent and severe as to require the use of chloroform. This agent, however, produced alarming depression, and oxygen was resorted to to correct its action, which it did very satisfactorily, but only to open the way for a return of the convulsions; chloroform was therefore repeated and its action kept within safe limits by the oxygen, until the tendency to convulsions passed away. The oxygen was then continued until, at the end of three days, the inflammatory products had become almost entirely absorbed, and the pulse, respiration and temperature had fallen, and the child desired to sit up. At this time, however, a relapse took place, and the whole of the lung became involved. Oxygen was again resorted to, to the extent of from 30 to 40 gallons daily, of which, however, a portion was wasted, as is necessarily the case in giving it to a child. Treatment otherwise expectant and supporting. In two days the patient was considered out of danger, and thenceforth the convalescence progressed steadily.

" Dr. Butler, of New York, reports, in the November number of the New York Medical Journal, a very interesting case of chronic pneumonia, in which the deposit was rapidly absorbed under the use of oxygen. (Andrew H. Smith in Oxygen in Disease.)

Dr. Read, of Long Island, has used oxygen in acute pneumonia to advantage.

Dr. C. F. Heywood, of New York, in a letter to Dr. Smith, says: I have seen the degenerative process of an old pneumonia retarded.

Although the existence of acute inflammation, as a rule, precludes the use of oxygen, yet, when respiration is seriously interfered with, the danger from this source outweighs all risk from any possible increase of the inflammation which the use of oxygen may occasion. In a case of double pneumonia, therefore, I should not hesitate to employ it, nor should I allow any case of this disease, which appeared to be tending toward a fatal termination to proceed without a trial of its effect. The fear formally entertained, that oxygen would excite pneumonitis by its *local* action is refuted by its entire history as a remedy. Especially in the typhoid form ot pneumonia, I should expect to get great benefit from the gas. (Smith's Essay.)

PHTHISIS.—Among chronic diseases, pulmonary phthisis was the one which offered from the first the most tempting field for the use of oxygen. It was natural to expect that the profound dyscrasia which lay at the root of the disease might be favorably modified by an agent bearing such intimate physiological relations to the normal blood. At the same time there was room to look for a double local action within the lungs. What might be the result of bringing an excess of free oxygen into direct relation with the tubercular matter in the pulmonary tissue was a question not less interesting than what might result from the local action of the gas upon the ulcerated surfaces with which it would come into contact.

After the lapse of eighty years these problems still remain but partially solved. With regard to the effect of oxygen upon the system generally in phthisis, we have abundant evidence to show that, *as a rule*, in this disease, as in others in which nutrition is defective, the use of the gas *favors assimilation and results in a gain in weight.* But whether it exerts an influence upon the morbific principle which constitutes the essence of the disease is a point which facts alone can determine, and up to the present time, sufficient facts have not been gathered to warrant a decided answer.

Lastly, numerous experiments show that oxygen in contact with a wound or ulcer acts as a stimulant, promoting the formulation of granulations, and, if carried too far, setting up active inflammation. We have in this fact at once a therapeutical indication, and also a possible solution of the want of success which has often attended the use of oxygen in phthisis, especially in the advanced stages. As a solution of nitrate of silver of appropriate strength applied with discrimination facilitates the healing of an external ulcer, so oxygen properly diluted and carefully employed, may have a healing effect upon ulcers of the lung. But as a strong caustic applied indiscriminately to external ulcers would often induce excessive action, so oxygen in excessive proportion may excite inflammatory action in ulcers of the pulmonary tissue, which, reacting upon the general system would produce fever and other symptoms apparently indicating an aggravation of the general disease.

These considerations show how far we are from the knowledge of the possible usefulness of oxygen in this dread disease. The effects heretofore obtained have resulted from a hap-hazard use, such as in the case of any remedy would have insured its total falure. * * * The quantity and the mode of administration should be regulated by the actual condition of the lung. In the first stage, when we may assume that the mucous surface is entire, the gas may be given with impunity, diluted with two or three times its bulk of air, but, even then, the symptoms should be carefully watched, and especially the temperature, and anything indicating the occurrence of local inflammation should be the signal for further dilution of the gas. There is no necessity for adding to the inspired air more than three or four per cent of oxygen in order to produce a decided effect upon nutrition by one or two inhalations daily of half an hour's duration each. An atmosphere of this kind could have no appreciable local effect even upon an ulcerated surface. (Smith.)

The following cases by Demarquay are taken from Dr. Smith's essay:

X——, aged thirty-two. Tubercles in both lungs; cavity in left of the size of an egg. Greatly emaciated. pale, anæmic, profuse expectoration, intense fever in the afternoon, diarrhœa. Tubercular epididymitis.

March 1st.—To take four litres of oxygen in ten of air, daily.

March 3rd.—The cough is less frequent, expectoration less abundant; slept well. Increased the dose to twelve litres.

4th.—A little appetite, but little cough, no expectoration.

6th.—Great appetite, sleeps well, physiognomy better.

8th.—Increased to fifteen litres.

10th.—Patient has been up and about for the last two days. Appetite so great that, after eating the dinner provided by the institution, he goes out and dines again in the city. Face has more color, cheeks filling out, respiration easier.

16th.—Cavity still remains, but the surrounding tissue which was hepatized now performs its function.

19th.—Able to take a long walk.

26th.—Cough and expectoration have entirely disappeared. No gurgling as formerly, respiration still amphoric.

April 30th.—Discharged in a very satisfactory condition. (Reported by Demarquay, p. 733).

Madame De B., aged twenty-seven. Tubercles in both lungs. Emaciation, frequent cough, profuse expectoration, almost no appetite, abundant night-sweats. The appetite improved and the strength increased, and, on the twenty-seventh day of the treatment by oxygen, patient was able to give a dinner party and preside for two hours at the table. The menses, which had been absent for five months, returned. The cough and expectoration, though less, persisted during the summer and toward autumn; the use of the gas having been for some time suspended, a relapse took place, and death followed the ensuing February. (Demarquay, p. 736).

"It is to be remarked that in this case all other treatment was suspended from the moment the use of the oxygen began."

M. C. B., aged twenty-six. For some years has had very abundant hæmorrhages. Signs indicate a number of cavities and an abundant deposit of tubercle, especially in right lung. At the commencement of treatment was so feeble that he could only be moved from the bed to the sofa. Abundant muco-purulent expectoration, complete anorexia. Twelve litres of oxygen were given twice a day, and within a brief period he had so far improved that he was able to walk in the garden, and even to attend occasionally to business. For sixteen months the treatment has been continued, during which time there has been no return of hæmorrhage, the expectoration is now insignificant, and the cough infrequent. The appetite is habitually good. Still the disease is making progress, the pulse is frequent, and the strength less than last year. But the oxygen has restrained the march of the disease, which last spring seemed to have arrived at its last stage. The improvement followed so immediately upon the administration of the gas that it could not be attributed to any other cause. (Reported by M. Monod, quoted by Demarquay, p. 739).

" Demarquay quotes, from notes furnished by M. Hervé de Lavour, an account of that gentleman's experience with oxygen in phthisis which is particularly valuable, as he gives the unfavorable as well as the favorable results. He says: " I have had only nine patients who have been submitted to a somewhat regular course of inhalations of oxygen. Among this number I have obtained three remarkable successes. The first was a phthisical case of old date, having enormous caverns at the summit of one lung, and who, at the time I prescribed the inhalations, had an abundant expectoration, fever in the afternoon, a frequent cough, and such a degree of dyspnœa as rendered the least movement fatiguing. Anorexia was complete. The inhalations of oxygen were prescribed at the dose of fifteen litres " (four gallons) " daily in two portions, mixed with about one-third of common air. Gradually the quantity of gas was raised to forty-five litres daily taken pure in two doses. Under this influence the expectoration ceased, the appetite returned, and the patient began to convalesce. The gas was continued two months, when the dose was diminished gradually and finally discontinued. For the last five months the patient has gained flesh, follows his usual occupations, and goes on as well as possible."

"In the case of the second patient there were crepitant *rales* in almost the entire extent of both lungs, with crackling at both apices, a frequent cough, an abundant expectoration, and a horrible dyspnœa, which compelled her to pass the greater part of her nights in her chair. "There was a consultation, and two of our most eminent practitioners gave the most unfavorable prognosis. The patient went on from bad to worse, and at last the appetite failed altogether. I prescribed inhalations of oxygen * * * and they were regularly employed for about a month. The dose of the gas was at first about fifteen litres, mingled with air, then twenty, and at last forty-five litres were given without any mixture. Under this influence the amelioration was rapid, the dyspnœa disappeared, the appetite returned, and the patient is now as well as possible, attending to all his affairs, and saying that he has never been better."

The third case is a patient having tubercles at the summits of both lungs, and having besides hypertrophy of the heart, with violent palpitations, and a dyspnœa which would not allow the least exercise. He was submitted for a month to inhalations of oxygen, the cough diminished, the appetite, which was *nil*, returned, as did also the strength. At the end of three months the patient was able to take long walks without experiencing either dyspnœa or fatigue.

"In the case of the other patients the results were much less satisfactory. Three among them, having cavities, experienced a slight benefit; three others perceived no favorable effect whatever, without my being able to discover in the condition of the patients the difference in the results obtained."

"Birch relates two cases, one in which auscultation, percussion and microscopical examination of the expectoration confirmed the diagnosis, as regards tubercular consolidation central cavity . . . . From the very first dose of oxygen a diminution in the sensations of irritation and weakness of the chest could be felt by the patient; within a month marked improvement evinced itself both in the lung and general health; at the termination of four or five months' steady treatment . . . . the flattening" (of the chest) "had given way to almost perfect symmetry. . . . . The following winter there was still some pain and sensitiveness to the impression of damp and cold air, but otherwise with a little extra prudence, she enjoyed herself like others. Two years after the commencement of the oxygen she was quite well, married, and has ever since enjoyed good health.—(Written eight years after.)" (Birch on Oxygen, p. 121.)

In the second case, the upper third of the right lung was full of small cavities, and soon broke up into a large cavity, which, under the influence of oxygen, afterward contracted, causing considerable depression of the wall of the chest. Treatment was continued intermittingly for a year. Patient quite well, six months after, (p. 123).

During February and March, 1869, a series of experiments were tried at the New York Hospital, on the effect of oxygen in phthisis. Ten men having phthisis in various stages were placed in a ward together, and inhaled each about three gallons of oxygen morning and evening. This was continued for about four weeks, when it was found that six had gained in the aggregate forty-nine and a half pounds, while the remaining four had lost seven pounds.

In several of the cases there was a rise in the temperature after the first three or four days, and the gas was discontinued for a short time, and again resumed, after which the temperature remained as before the administration. A transcript from the hospital records will be found in the New York Medical Journal for September, 1869, and is worthy of attentive perusal. While the most prominent fact is the increase in weight, yet, in several of the cases there was a very marked improvement in other respects, and that, too, when the patient had been growing worse up to the moment of beginning the inhalations.

In those cases in which the gas seemed to disagree with the patient it is probable that the result would have been very different if it had been given more diluted.

The figures in Case V. are very remarkable. "February 15th, weight 127 lbs.; March 5th, 124½ lbs.; March 10th, inhalation resumed, weight 123 lbs.; March 16th, 126 lbs." This is one of the cases in which oxygen at first disagreed. (Smith's Essay.)

Mrs. W., aged forty. Had been phthisical for eight years, having frequent hæmorrhage, and being very much reduced in flesh and strength. The summer of 1858 was spent out of town, she being unable to bear the air of the city. While in the country she had a succession of hæmorrhages which left little prospect of even a temporary rally. She improved somewhat, however, and returned to the city, where she passed the winter in a state of extreme feebleness. With the approach of warm weather she prepared to go again into the country, but before doing so decided to try the effect of oxygen, hoping it would take the place of a removal out of town. Accordingly, she inhaled twice a day about four gallons of the gas, and found her stregth and appetite so much improved that the change to the country was abandoned. During the summer two very slight hæmorrhages occurred, but her health in the main was infinitely better than the preceding year, notwithstanding the disadvantage of remaining in the city. She had continued the use of the gas, with occasional intermissions, up to the present time. She can not omit it for more than a week without being sensible of a retrogression. Unfortunately the physical signs were not noted at the beginning of the treatment, so that we can have no definite measure of her improvement. But the fact remains that the summer, which has always been the most trying season for her, has been passed with great comfort. That this was due to oxygen is shown by the effect of occasionally omitting its use. (Smith's Essay.)

An interesting case, reported by Dr. Wallian in Medical Record:

"D. F. A—, a railway engineer, aged twenty-eight single. Sent to me from a distant part of the state by his family physician. Father living, mother died of phthisis at thirty-eight. Says he has always been rugged with the exception of coughs and cold in winter. Admits that he formerly lived a little "fast," and that he had a little touch of specific trouble several years ago. A homœopath "cured" two sores (chancres?) on the prepuce several times for him, the last one year ago. On the day following Easter, 1884, while at a circus, a profuse hæmoptysis occurred suddenly and without warning. He was removed to the nearest physician's office, but bled so rapidly as to lose consciousness, and it was some hours before he rallied sufficiently to be carried home. Arrived here May 8, 1884.

May 9th.—Physical examination developed the following conditions: Figure slightly stooping; weight, 140; chest narrow and barrel-shaped; pulse, 110, and wanting in volume; temperature, 99.9°. On percussion, find an area of dullness over the upper portion (not apex) of right lung, 5 x 5 inches. On forced expiration chest measures 30½ inches; on forced inspiration, 31¼ inches, showing an expansive capacity of only ¾ inch. Very loud tubular breathing over right bronchus. Appetite capricious, the sight of an unsavory dish being sufficient to destroy it at any time.

Realizing the danger of recurring hæmorrhages, he is placed on a modified mixture of oxygen and nitrous oxide, well diluted with common air, and is cautioned against making any unusual effort when inspiring. Under this restriction he inhales four inspirations of 50 cubic inches each, b. i. d.

May 9th, 7:45 P. M.—Pulse, 100. Four inspirations, as above, reduce the pulse to 92 *within two minutes.*

May 10th.— Pulse 88, after treatment; respiration, 28.

May 12th, 5:00 P. M.— Has just walked half a mile; pulse, before inhalation, 117; after, 108.

Patient has heretofore been an inveterate smoker, consuming six or eight cigars of an evening. He is astonished to find his appetite for the weed entirely gone, and attributes it to three days' use of oxygen. As I have not before observed this result, further tests are necessary before announcing oxygen as a panacea for the tobacco habit. Dosage, 2 gallons, b. i. d.*

May 14th.— Pulse, before treatment, 108; after, 102; and at the end of thirty minutes, 82.

May 16th.— Pulse, before inhaling, 81; after, 76.

May 18th.— Pulse, before treatment, 95; after, 85.

May 22d.— Chest measurement slightly increased, and he can now easily inspire 130 cubic inches at each effort. Can walk five or six miles at a stretch without much fatigue, and feels very much encouraged. Eats and sleeps well. Pulse, before treatment, 82; after, 88; temperature, 99° F.

May 27th.— Pulse, before inhaling, 108; after, 94. To supply new material for the reparative processes evidently being inaugurated, I place him on Phillips's Wheat Phosphates, urging plenty of fresh beef, milk, mutton, eggs and cream, with inunctions of cod-liver oil and glycerine three times a week, at night, to be followed in the morning by a hot bath, medicated with aqua ammonia and borax. He is also directed to imbibe half-pint of hot water before each meal, and at bed-time, daily.

---

*I have observed the same thing in one case; a gentleman who was taking oxygen for dyspepsia, remarked that while taking it he lost all appetite for his tobacco. He had been a hard smoker for twenty-five years, and had never before experienced a disinclination for it.—(AUTHOR.)

May 31st.— Pulse, before treatment, 108; after three inspirations (five minutes), 96; temperature, 98.9°. There is a mild form of syphilide showing itself on the chest and back. Iodide of potash is added to his treatment, grs. x., t. i. d. Proportion of oxygen increased.

June 2d.— Pulse, before treatment, 84; after, 82; respiration, 24.

June 7th.— Before treatment, pulse 86; after four inspirations, 84. Chest now measures 30½ and 32 inches, a gain of ¾ inch in expanding capacity. Pulse-volume increasing. Dosage increased to three gallons, b. i. d.

June 20th.—Patient steadily gaining; can now inspire 150 cubic inches at an effort; chest measures on forced inspiration 32¼ inches. Dull area is smaller, and the vesicular murmur can be faintly heard over much of it. He can walk ten miles or more a day without fatigue. Treatment suspended, a pressure of summer travel requiring him to return to his post, promising to return in the fall. Weight, 145 pounds.

September 5th.— Returns, as per promise, weighing but 133 pounds. Has had no second hæmorrhage. Pulse, 88; temperature, 98.8°. Chest measures 29¼ and 31 inches. Dry tubular breathing over right bronchus. The eruption is nearly gone.

October 1st.— Tubular breathing still distinct but smoother. Area of dullness much smaller. Order Phillips's Wheat Phosphates with syr. pruni virg. and tr. nucis vom. Chest measures 29¾ and 31¾; temperature, 89.9°.

October 24th.—Dullness nearly gone. Eats and digests well. Pulse 90, and quite full; temperature (8 P. M.), 99°.

November 27th.— Tubular breathing much less distinct. Pule, 80; temperature, 99; respiration 20.

January 4, 1885.— Pulse, 93; temperature, 97.7°; respiration, 20.

February 19th.— Pulse, before inhaling, 98; after, 93.

March 10th.— Pulse, before inhaling, but after excitement, 104; thirty minutes later, after four inspirations, 96. Tubular breathing still audible but vesicular, murmur nearly as loud over the former dull area as elsewhere. Respiration still a little hurried — 20 to 22 — higher after exertion; but patient eats and sleeps well; weighs 144 pounds, and feels competent to return to his occupation. Treatment suspended. Have heard from this patient during the summer, and always favorably."

The two following cases occurred in my own practice:

Mrs. D., æt. 40, married, mother of two children. Was referred to me for examination of her lungs. Had been pronounced consumptive eight years ago, and told by her physicians that a change of climate was the only thing which could benefit her. For a number of years went north during the summer, but made no other change of climate. The disease did not appear to make very rapid progress, and at times patient was quite free from symptoms, while, again, she coughed badly, had hæmorrhages, and seemed to be on the verge of a rapid decline. On the whole, however, she managed to live and enjoy a fair share of life's pleasures. Six months previous to consulting me she began to grow rapidly worse, had severe hæmorrhages, night-sweats, muco-purulent and blood-streaked sputa, great dyspnœa, cessation of menses, evening temperature from 102° to 104°, exceedingly nervous, hysterical. She did not come to me for treatment, but only for thorough examination, and to consult me as to the advisability of going west. (She came from a neighboring city.) On inquiry, I learned that the family history was very poor. Mother, one uncle and two aunts, on the maternal side, dying of consumption, a brother also a sufferer from the disease, and would doubtless have succumbed to it, had he not met his death by accident, at the age of twenty-seven. Mrs. D. had always been delicate, but did not develop pulmonary symptoms until after marriage. The right lung was found to present the three stages of phthisis in well marked degrees. There was a cavity and extensive softening at the apex, subcrepitant, mucous and gurgling rales. The middle and lower lobes presented areas of infiltration, in fact, at the base of the lung, posteriorly, there was entire absence of respiratory movement. Left lung. — Exaggerated respiration and subcrepitant rales over the infra-clavicular and mammary region. In the infra-axillary region well marked pleuritic sounds, and, upon inquiry, found that she had had pain in this region for several weeks.

I gave the family no hopes that she would ever be any better, but strongly urged that the oxygen treatment be given a trial. After some consideration they decided to try the oxygen. This was before I had my oxygen apparatus complete, so patient began by taking the "compound oxygen," or, in other words, the nitrous oxide, at one of the "oxygen parlors" in the city. But very small treatments were taken at first, as the inhalations caused pain in both lungs, and great weakness. The treatments were followed by marked relief from dyspnœa, and increased strength. In ten days the patient had made an astonishing gain. Cough, night-sweats, and nervous symptoms greatly improved. The treatment was continued about four weeks, the patient improving rapidly. At the end of this time I had my apparatus completed, and she was put upon the modified mixture. This she found much more agreeable, and it did not produce the pain in the lungs, only causing a gentle warmth to pervade them, and it was altogether pleasant to take. She did not, however, continue the use of the modified mixture for any length of time, owing to the difficulty of transporting the gas, she having in the meantime retured to her home. Owing to her rapid improvement she was anxious to continue the use of the oxygen, and it not being available in her own city, she purchased the formula for compound oxygen, and thereafter manufactured it herself. At the expiration of ten weeks the patient was in better health than at any time since her marriage. The lungs cleared up in a manner truly marvelous, the left one exhibiting scarcely a trace of the former difficulty. The gurgling rales almost disappeared from the apex of right lung, only a few subcrepitant rales remaining. Broncho-vesicular breathing at the base of the right lung and the infiltrated areas rapidly decreased.

Oct. 22d, 1886.— It is now almost a year since this patient began the treatment. She has just presented herself to have another examination of her lungs made; she states that she has improved steadily from the very first, her health being better than for years past. She rarely coughs, or has any pain in her lungs, unless it be after taking a slight cold.

Upon examination, it seems difficult to believe that her lungs were ever in the condition described above. The cavity, of course, still remains, though, owing to the healthy condition of the surrounding lung-tissue, it is much smaller. At the base of the right lung there is a slight dulness on percussion, though the respiratory sounds are distinct over the entire area of the former consolidation. At the base of the left lung there is evidence of some pleuritic adhesion. No rales of any kind are heard in either lung.

N. C., aged 30, colored coachman. Was under treatment for tubercular phthisis at the time I put in my oxygen outfit. As soon as arrangements were completed, he was placed upon the mixture. Condition at this time was as follows: He was confined to his bed, much emaciated, unable to take even liquid nourishment without causing pain in stomach, and greatly aggravating a troublesome diarrhœa. Suffering from profuse night-sweats, bad cough, with profuse blood-streaked expectorations, temperature ranging between 100° and

104°. Physical examination.—Numerous moist rales heard at the apex of both lungs, with signs of two small cavities. Broncho-vesicular breathing in the mammary region. Entire absence of vesicular sounds in subscapular and infra-axillary region. Oxygen was sent to this patient in a rubber gas-bag. The usual proportion was administered at first, which was changed, after four or five days, by increasing the proportion of oxygen one volume. The rapidity with which this man gained was almost beyond comprehension. The night-sweats were soon checked, cough and diarrhœa diminished rapidly, temperature declined so that the evening rise was not over 101°. At the end of the first week he put his clothes on and walked about the house, and by the middle of the second week surprised me by walking to my office, a distance of three-quarters of a mile. In a few days after this he came regularly to my office for treatment. At the expiration of three weeks he wanted to go to work, but to this I would not give my consent; he, however, did some light work about the house. In a month he had gained fifteen pounds. Coughed but little, slept well and had an enormous appetite. But alas! here the good report ends, for about this time an incident occurred which changed the tide of events, and blighted the hopes I had begun to cherish of reporting a case of advanced phthisis arrested by the oxygen treatment. The domestic misunderstanding, which resulted so disastrously to my patient and indefinitely postponed the hope I had cherished, was something as follows: One cold night, in January, the patient under consideration bethought himself that a fire in his sleeping apartment would add very materially to his comfort and well-being, but this announcement was greeted by his aged mother as an unwarranted extravagance, for the very thought of which he was severely admonished and sarcastically reminded that the summer kitchen was warm enough, a night like that, and, withal, good enough for a worthless being who would harbor such high-flown notions. The upshot of the matter was that our patient repaired to the kitchen, built a fire in a rickety stove there, and turned in for the night upon an ironing board. Toward morning, the fire having gone out, he awakened with a chill, and the next day had a slight hæmorrhage. From this time on the oxygen proved unavailing, and in a month's time the patient ceased to be.

I realize that some of my readers will smile at the inglorious termination of the case, and mentally scoff at the idea of the occurrence related being more than indirectly responsible for his death. Be that as it may, the writer will ever adhere to the conviction that his promising patient was sacrificed, a martyr to rigid economy and willful cussedness.

Dr. J. Solis Cohen, (Inhalation in the Treatment of Disease), quotes the following case from Beigel:

An engineer, twenty-three years of age, of scrofulous diathesis, with tuberculous infiltration of the left apex, and bronchial catarrh of the right lung, with hæmoptysis, coliquative perspirations, and rapid loss of flesh, was so much improved by the inhalation of a gallon of oxygen twice a day, and of a solution of the sesquichloride of iron twice a day, that in a little less than five months, at which time the treatment was discontinued, the patient could hardly be recognized as the same man; he had grown strong and muscular, and, but that dullness remained at the left apex, he could be considered as perfectly healthy. He was seen a year afterwards by Dr. Beigel, whom he assured that he had enjoyed very good health during the whole of that period.

Mrs. J. S., aged thirty-nine, married, two children, the youngest seven years old. By profession a singer and teacher of music. Family history includes phthisis, of which she lives in great fear. Each winter has severe bronchial and laryngeal troubles, with persistent cough. Anæmic, extremities habitually cold; pulse, 102 to 108; constant subclavicular pain; dyspnœa and fatigue on slight exertion; weak digestion, with bowels habitually constipated. She expectorates rather copiously; sputa muco-purulent; and there is circumscribed dullness over the apex of the left lung. She is very despondent, and has no faith that any treatment will avail.

March 25th.— She presents for treatment and is placed on daily inhalations for thirty minutes at a sitting — ℞ Oxygen, 25 volumes; nitrogen monoxide, 50 volumes; common air, 25 volumes. At a forced effort she can inspire 150 cubic inches of the mixture.

April 10th.— Improvement has been manifest from the first. The nitrogen monoxide acts as a wonderful calmative to the nervous system. She is no longer despondent; appetite much improved, coughs less, sputa reduced in quantity and less purulent. *Constipation effectually relieved.* Lung capacity, 190 cubic inches.

April 25th.— Resumed her music classes soon after last record. Improvement has been rapid and constant. Says she is "better than for many years"; eats, works, and sings with gusto. Considers herself "well," and treatment suspended.

(Observed this patient, eight months later; no outward symptoms reappeared.)

Mrs. C. L. W., aged twenty-nine, married, one child aged five. Family history says father died of cancer of stomach; mother of cardiac disease. She has "weak lungs," and lives in perpetual dread of "consumption." Sense of constriction of left lung; circumscribed "sore spot" under the left clavicle; severe cough for several years past, and there is now some dullness on percussion over the left apex.

Has been treated by eminent physicians without appreciable benefit; very anæmic; voice weak; no appetite; amenorrhœic for three years past, menstrual discharge, when present at all, is either profuse, acrid and colorless, or greenish in color, scanty and offensive. Has been subject to repeated attacks of severe nephralgia. Urine not examined.

May 23rd.— This patient was placed upon a mixture of— ℞. Oxygen, nitrogen monoxide *aa* 2 volumes; common air, 1 volume, of which she inhales twice daily, three gallons at a sitting. Shows a lung capacity of 130 cubic inches.

June 1st.— Improvement already manifest. Feels "rested," eats better; says the soreness has nearly left her. Can now inspire 165 cubic inches at an effort. Treatment continued twice daily.

June 15.— Acute nephritis suddenly developed, or at least, the chronic condition of those organs assumes a subacute form. Temperature, 102; pulse, 122. Urine scanty. Specific gravity, 1,030; some albumen and casts. Oxygen suspended and hot hip baths ordered, with demulcent drinks, tobe followed by hot fomentations over the region of the kidneys.

June 23.— The acute symptoms, which were somewhat alarming at last record, soon subsided, and general improvement is very evident. Lung capacity, 200 cubic inches. Oxygen was resumed 20th.

The following, though it can scarcely be considered a case of phthisis, from the nature of the symptoms is reported under this head.—AUTHOR.

Mr. K., aged twenty-seven, married, carpenter. Consulted me for a cough of several months' duration; had not given it any attention, as he considered it the result of an ordinary cold. The appearance of a tenderness in the upper portion of the right lung induced him to seek my advice. This latter symptom had made its appearance several weeks previous, and had grown steadily worse. When doing light work or exercising, pain was scarcely noticed, but heavy work, severe exercise of any kind, or coughing, aggravated it, and after retiring he was often kept awake by it. Examination revealed a dullness on percussion, over a circumscribed area, at the apex of the right lung. Prolonged, high-pitched respiration over the affected area, and numerous small mucous rales were also heard. There were some febrile symptoms, but as he had been subject to malarial trouble for a number of years, and had experienced many ague symptoms recently, I could not, with certainty, attribute the rise of temperature to the pulmonary trouble. His family history was good, there being no tubercular tendency so far as he knew upon either paternal or maternal side. His appearance was anything but that of a consumptive, he having a splendid physique and weighing 185 pounds, and was, in fact, a good all-round athlete. He was put on the usual mixture of gases, commencing with two gallons daily, and increasing until eight gallons a day was given. He had a fine chest capacity, and prided himself upon the amount of gas he could take at an inhalation, and either from this extra exertion or from the effect of the gas the pain in his chest was at first increased, but in the course of a week an improvement was manifest, which continued, and in three weeks the pain had almost ceased. The treatment was kept up for six weeks, the cough having disappeared in the meantime; the febrile symptoms also abating. Examination of the lung gave evidence of but the merest trace of the former trouble. It is now several months since ceasing the treatment, and he has had no return of cough or pain in the chest.

Dr. Read (Long Island) has reported a series of twenty cases treated by inhalation of oxygen in conjunction with cod-liver oil. The majority did well, and he reports it "an admirable adjuvant to the usual routine treatment of phthisis, especially when the patients are unable to go out of doors." He gave the gas also in acute pneumonia, and apparently with advantage. (Phillips' Mat. Med. and Ther.)

Drs. Mackey and Constantine Paul have each reported a number of cases of phthisis arrested by the use of oxygen.

Diseases of the Digestive Organs, Liver, Kidneys, Etc.

DYSPEPSIA.—In this disease oxygen has succeeded when all other means failed. Its most unqualified commendation is by Trousseau, whose knowledge of the resources of therapeutics has rarely, if ever, been surpassed. He speaks of having by its means in several instances "*recalled to life* women regarded as lost," from great depression of the digestive powers consequent upon puerperal hæmorrhage or excessive lactation. He cites, as an example, the case of a girl twenty-two years of age, delivered and exhausted with nursing. Her features were "absolutely those of a cadaver." She was admitted to the hospital April 1, 1864. The treatment began by weaning the child, but for fourteen days there was no improvement. She had continuous fever, pulse 120 to 130 skin hot and dry, and constantly increasing debility. The debility became so great that she could not sit up in bed without fainting, and auscultation was rendered almost impossible. It was ascertained, however, that there were no tubercles. Tonics and iron were tried, and failed completely; the anorexia remained absolute. On the 14th of April she began inhaling oxygen; very little was given her the first three days; the first attempt to inhale caused syncope. Still, by the 19th, she was able to sit up in bed and eat a little. Pulse, 104. The 19th she sat up for an hour, and asked for food. Pulse 92, skin cool. The 24th the pulse fell to 80; the patient went down into the garden, described her appetite as *voracious*. April 30th the pulse was 72 to 80, and had been so for the last four days. The patient desired to leave the hospital. But she was still pale, "the living fiber having gained its tenacity sooner than the blood its normal constitution." (Clinique Médicale de l'Hôtel Dieu, tome iii, p. 64.)

Demarquay also relates similar cases in which the oxygen gave very prompt and decided relief.

"Birch insists strongly on the power of oxygen to remove congestions of the liver, and to relieve dyspeptic symptoms consequent upon them. He cites a number of cases which sustain his views.

"With regard to the possible effect of oxygen upon chronic disease of the liver, an observation of Hanfield Jones is very significant. In an article on the Function and Diseases of the Liver, he says: 'The oily contents of the hepatic cells are subject to great variation, both in individuals and in different classes of animals; the less perfect the type of the respiratory process, the greater the quantity of oily matter in the hepatic cells.' This statement suggests the inquiry how far fatty liver may be owing to defective hæmatosis. May it not be that the confinement which produces the *foie gras*, so delicious to the epicure, acts by preventing the reception of a due proportion of oxygen into the blood. Surely the 'type of the respiratory process' under such conditions must be anything but perfect. In the human subject, sedentary habits or improper alimentation may act to diminish the capacity of the blood to carry oxygen, and thus a condition of the respiratory process be produced approximating to the type of those classes of animals in which the hepatic cells are normally loaded with fat. Accepting this hypothesis, the systematic use of oxygen ought to be beneficial in such cases." (Smith's Essay.)

INDIGESTION AND HEADACHE.—Mr. S., aged about fifty, married, banker, consulted me in June for indigestion and "nervous sick-headache," which were attributed to over-work and to the confining nature of his business. His stomach had troubled him more or less for a number of years, also the headaches, but for several months previous to his taking this treatment both had been growing much worse, and he was often entirely unfitted for business. He had been subsisting on liquid food for a number of weeks, any solid food giving him great distress for hours after eating, and usually culminating in one of his severe headaches He was put upon the modified oxygen mixture, commencing with three inhalations a day; this number was increased until he took six deep inhalations daily. At the expiration of three days he felt much relieved, and was enabled to partake of a moderate meal of solid food without causing any gastric uneasiness or headache. This improvement continued; headaches only came at long intervals, and as a result of some unusual work, or after overloading his stomach. Treatment was continued several months, though after a time but three treatments a week were taken. Headaches now come on occasionally, but not as severe as of old, and he can always ward them off if a dose of oxygen is taken as soon as the premonitory symptoms are experienced. Several times, when the headaches had attained their usual severity they were dissipated at once by a few inhalations of the mixture. (AUTHOR.)

V— A. S—, aged fifty-one, married, several grown up children; occupation, commission merchant. Has been twenty years an invalid; a confirmed dyspeptic, and suffers from constant and extreme nervous irritability, and prostration (neurasthenia?). Constant frontal headache and frequently-recurring paroxysms of a dull, benumbing pain referred to the medulla and base of the brain. Appetite wanting; constipation habitual, alternating occasionally with diarrhœa; extremities cold, is very despondent, has suffered for years with a masked or "dumb" ague. Liver and spleen somewhat enlarged; urine turbid, and specific gravity 1030, abounds in alkaline phosphates, but deficient in urea and uric acid.

September 20th.— Daily treatment instituted, using—
℞ Oxygen, nitrogen monoxide, *aa*, four gallons, at each sitting. Lung capacity, 160 cubic inches.

September 29th.— The evidence of retention of urea in the system corroborated, and the value of oxygen as an eliminator well illustrated. Crowding the treatment from day to day, patient last night inhaled eight gallons of the mixed gases. Urine now loaded with urea; specific gravity, 1035. Treatment continued, the dosage diminished.

October 11th.— The disturbances noted after first week of treatment have nearly subsided. Urine nearly normal as to quantity, but still shows excess of urea; specific gravity, 1028.

Mixture changed to — ℞. Oxygen, one volume; nitrogen monoxide, two volumes; eight gallons at each daily sitting. Lung capacity increased to 200 cubic inches. Patient is less irritable, sleeps better, and feels greatly encouraged.

October 18th.— Improvement has been gradual but constant since last record. Cephalagia is becoming a much less frequent symptom, and when present is less severe Specific gravity of urine, 1025.

November 11th.— Has steadily improved since last record, in spite of the drawback of constant business worry and overwork. Urine normal; lung capacity, 220 cubic inches.

November 20th.— Digestion good; sleeps well; no longer despondent or irritable; no headache; extremities in a comfortable glow, all his functions well performed, Treatment discontinued.

(Four months later this patient reported himself in active business, and feeling strong and well.) (Dr. Wallian, Medical Record.)

Mrs. W. M. H——, aged forty-one; a good sample of the "lymph-albuminous" subject referred to by Bartholow. Very short of stature, but weighs one hundred and fifty pounds. Family history shows hereditary tendency to phthisis, rheumatism, and insanity! Suffers from frequent attacks of arthritis and daily recurring "stupid spells," in which it is impossible to keep her from indulging in a lethargic sleep, varying in duration from half an hour to three hours. Subject also to a "bilious" form of indigestion, with "sour stomach," periodic vomiting, and prostrating headaches.

In this case treatment was irregularly and spasmodically followed for several months, relieving the indigestion, and at the same time *reducing the body-weight ten pounds!*

She goes through the whole day without a "sleepy spell," the rheumatism yields with the aid of a little oil of wintergreen; no vomiting and no headaches. From being depressed and indifferent is now ambitious, active and cheerful. (Ibid.)

ALBUMINURIA.—In a few cases of Bright's disease, narrated by Dr. C. Paul, albumin disappeared from the urine during treatment by oxygen. This occurred also in the often-quoted case observed by Kollman and Eckart (Schmidt's Jahrb, 1865). More recently Dujardin-Beaumetz reports a case "in the last stage," and in which every diuretic had proved useless, and yet twenty-four hours after inhaling oxygen, the albumen disappeared, and was still absent twelve days afterward when the case was reported (Medical Record, March, 1879.) Other physicians, while recording similar cases in their own experience, stated that the good results were not of long duration. (Philips' Mat. Med. and Ther).

Dr. J. F. Hammond reports that he has used oxygen with success in albuminuria.

In some cases of this disease the albumen in the urine may greatly diminish, or for a time disappear entirely, under the use of oxygen. I have seen two cases of this kind. The amendment, however, was but temporary. (Half-Yearly Compendium, January, 1869.)

"The frequent occurrence of albuminuria in pneumonia and other diseases or conditions involving the respiratory function, is a suggestive circumstance in this connection." (Dr. A. H. Smith, in Oxygen in Disease).

DIABETES.—Pettenkofer and Vogt determined that diabetics absorbed less oxygen than healthy persons, and that hence we might hope, by introducing more into their system, to obviate some of the conditions of their malady.

Bouchardat, and also Demarquay, have recorded cases relieved by this treatment, but no extensive trial of it has been made. Peroxide of hydrogen has been given internally with the same object—of oxygenation—and with some partial success.

I have tried oxygen inhalation in several cases ot diabetes in which prostration, dyspnœa, and tendency to cyanosis were prominent symptoms—one case was at the very unusual age of seventeen months, another at thirteen years, and three others at adult age. The gas certainly relieved for a time the symptoms mentioned, although it did not in any instance reduce the sugar in the urine. (Philips' Mat. Med., p. 13).

Demarquay, referring to the effect upon diabetes of a residence in the dense atmosphere of the sea shore attributes it to the greater quantity of oxygen inhaled, and adds:

"In support of these facts I may cite the results which I have obtained with inhalations of oxygen in the case of several diabetics, without changing their regimen in the least. I have seen the quantity of sugar in the urine diminish in a notable manner. The figure may descend in a few days to one-half of that usually observed at the same time that the strength is seen to revive. M. Berenger-Ferand, a very distinguished young naval surgeon, as also Dr. Yvan, who have both applied, at my instance, inhalations of oxygen to the treatment of diabetes, have modified advantageously the condition of their patients. Without doubt, we have only acted upon the symptoms of the disease, but, in the present state of science, what other treatment can we apply to diabetes, since science has not determined either the nature or the real cause of the disease?"

An observation of Bouchardat is very significant in this connection. It is to the effect that an excess of sugar may exist in the blood without glycosuria, but the moment the respiratory function is interfered with, as, for instance by a bronchitis, sugar appears in the urine.—(Revere des Cours Scientif, Jan. 2, 1869.) (Dr. A. H. Smith, in Oxygen in Disease).

"I have treated only two cases of diabetes by inhalation of oxygen, but both were well-marked cases of the disease. The urine in both was excessive in quantity, high in specific gravity; in one over 1040, in the other over 1050. One had double diabetic cataract, and the other puffiness of the retina with impaired vision. Both improved very rapidly under the use of oxygen gas—the quantity, the specific gravity and the amount of sugar decreased rapidly. Emaciation, which in one case amounted to about 40 pounds in six months, ceased, and both gained in flesh. What is rather remarkable in both cases, the disease, since ceasing the use of the gas, has made no perceptible progress—although it is now nearly six months since I ceased to give it in the first case." (Dr. Howard Pinkney),

In a letter to Dr. Smith, Lt.-Col. J. F. Hammond, Surgeon U. S. Army, says he has used oxygen successfully in diabetes mellitus.

DYSPEPSIA AND SPERMATORRHŒA.—L. P. N——, aged twenty-five; theological student; nervous temperament; family history good, but is a confirmed dyspeptic, and has spermatorrhœa of several years' standing, nocturnal emissions occurring almost every night. Over the latter he is depondent even to desperation Fears he is going into a "decline." Studies hard far into the night, preaches, becomes very excitable; after which he suffers from protracted insomnia. Has consulted a number of physicians here and elsewhere, but without benefit. Is now trying movement cure, but thinks it weakens rather than strengthens him.

April 13th.— Begins the use of a mixture composed of O one volume, N_2O two volumes, and common air two volumes. Lung capacity, 160 cubic inches; countenance expressing haggardness and hopelessness; urine loaded with oxalates.

April 20th.— Already reports a marked change in his appetite and digestion. Says his food no longer distresses him.

April 30th.— Nocturnal emissions have entirely ceased! He sleeps and eats well, and does not give way to excitement as formerly. Lung capacity, 190 cubic inches. Feels greatly encouraged.

May 10th.— Improvement has been constant and rapid since last record. Appetite and digestion excellent. Has gained in flesh, feels fresh and buoyant, and no return of emissions. In short, this patient is quite himself, and attributes the change wholly to the oxygen treatment. Lung capacity, 200 cubic inches. No further treatment deemed necessary, and patient passed from observation.

RHEUMATISM AND GOUT.— But little is known as yet of the effect of oxygen in these diseases. Dr. Golden (Lancet, March 10, 1866), observing that the lithic-acid diathesis appeared more decided in cases in which respiration was imperfectly performed, was led to try the effect of oxygen in gout. The result was very satisfactory. Since then, Kollman, an apothecary, of Munich, has experimented as to the effect of the inhalation of oxygen upon the quantity of uric acid excreted. He found that it produced an immediate diminution, and that, after continuing it a few days, the uric acid entirely disappeared from the urine. The treatment certainly deserves a trial in these diseases. (Smith's Essay.)

RHEUMATISM AND INSOMNIA.— Mrs. H., age thirty-three, widow, came to me early in January upon recommendation of some former patient. States that she had been unable to perform her household duties for about three months, during which time she had been under the treatment of several physicians, without any improvement.

Her most urgent complaints, at the time, were insomnia and migratory rheumatism, to which she adds the following list of secondary troubles: anorexia, flatulent dyspepsia, obstinate constipation, and dysmenorrhœa. The simplest food in small quantities caused much distress from distension of the stomach and abdomen and sour eructations. Bowels rarely moved without the aid of laxative or enema. Rheumatic pains very annoying at all times, but much aggravated every morning: Was always awakened by pain, which at one time was in the shoulder, then the hip, elbow or ankle.

She was put upon what I term the standard mixture, consisting of oxygen, two volumes; nitrous oxide, two volumes; air, four volumes, commencing with four inhalations daily, which were increased gradually until eight inhalations were taken at a treatment. The very first treatment was productive of the happiest results, patient announcing with much satisfaction the next day that she had enjoyed the best night's sleep she had had for months. During the first week little change was noticed in the gastric and enteric symptoms, although she thought she had more desire for food, but still felt distressed after eating. At the end of the second week noticed marked improvement in the appetite, less pyrosis, bowels moved without enema or laxative, though not without some difficulty. Still said she was much troubled with burning in the epigastric region. These symptoms all improved gradually, and a little before the expiration of the month she discontinued the treatment, declaring herself well, which appearances certainly seemed to indicate, as she had gained much in flesh and strength.

CHOLERA.—Dr. J. S. Cohen, in his work on inhalation, gives a few notes regarding cholera; among them he speaks of Dr. Wittmeyer, of Nordhausen, having suggested oxygen inhalations together with vapor of water in the stage of asphyxia in cholera, and says that Dr. W. was led to employ oxygen because the absorbent powers and alimentary canal being out of order, and hypodermics having failed, the respiratory organs were the only ones remaining whereby aid could reach the suffering system. He contended that oxygen would more promptly excite the heart to action than any ordinary medicine which could be administered by other methods.

Dr. Cohen mentions some very favorable results obtained with oxygen by DeSmyttere in the epidemic of 1832, also during a cholera season in India in the year 1850, reported by Macrae, together with several other instances. He also states some failures, even where the administration had been conducted with great care.

Diseases of the Blood; Asphyxia and Poisoning.

ANÆMIA.—Mr. S., aged seventeen, upward of six feet tall, has grown very rapidly in the last two years. Eighteen months ago he was attacked with a malignant pustule, affecting the cheek; he convalesced from this very slowly and was still feeble when he was seized with articular rheumatism, from which he suffered nearly the whole of last winter. After all inflammatory symptoms had passed, the least effort would bring an excessive pain in the joints, so that he lay for weeks in an almost helpless condition. At last he became able to walk a short distance with the aid of a cane, but still suffered greatly from pain, and stiffness in the right hip.

In this condition he first came under my care. He was pale and anæmic; pulse 108, and so feeble that it would be lost every few seconds and the counting have to be begun anew.

His appetite was good and had been so during his whole sickness. Tongue clean, bowels regular. Had been taking iron and other tonics for a long time with no benefit. He began on the 27th of September to inhale four gallons of oxygen each morning. For the first two weeks the pulse fluctuated between 104 and 120, but by the third or fourth day it had gained decidedly in strength and could be counted without trouble. His strength improved rapidly; he laid aside his stick and was able to walk a number of blocks without fatigue. By the 25th of October his pulse had fallen to 84 and was of good volume and strength; the gas was then discontinued. He has now resumed his business of insurance broker which he conducts with a great deal of energy.

Wilhelm N., aged twenty-eight, had been becoming more and more feeble and bloodless for four months, probably from the effects of syphilis, from which he had suffered severely, although there was no longer any external manifestation of the disease. Had been under the care of Dr. P. Hirsch, who gave him quinine and iron, which had benefited him slightly, but as he was not progressing satisfactorily he brought him to me for a course of oxygen. I first saw him on the 23rd of November, he was then very anæmic; conjunctivæ and nails white, hands cold, pulse 96 and very feeble, no cardiac souffle. Had an absolute disgust for food, and was very restless in his sleep.

Gave him at once four gallons of oxygen, the inhaling of which occupied about ten minutes, to contine the use of tinc. ferri chlor. The following day the pulse had fallen four beats and there was a little appetite.

November 25th.—A further decline of four beats in the pulse, appetite improving.

November 26th.— Pulse 84; appetite quite good, complains of constipation and headache; ordered ex. senna fl.

November 27th.— Pulse 96; bowels moved freely but headache still continues.

November 28th.— Pulse 80; headache no better. To omit the iron.

November 29th.— Pulse 76; head still painful, ordered potas. bromide, gr. x, ter die.

November 30th.— Head somewhat better; pulse 84; appetite very good, nails pink, conjunctivæ still pale, but not so much so as at first.

December 1st. – Head much better, strength greatly improved.

December 2nd.— No more headache; has an excellent appetite, from this time he steadily improved. (Smith's Essay.)

Dr. G. H. Butler, (New York Med. Jour., Feb., 1870,) reports three "strongly marked cases of anæmia" cured by inhalations of oxygen.

LEUKÆMIA AND PSEUDO-LEUKÆMIA.— In a lecture given by Dr. Kimberger, before the Medical Society of Mayence, on the treatment of leukæmia and pseudo-leukæmia, he suggests the inhalation of oxygen as a means of obviating the retarded tissue metamorphosis which is characteristic of this disease. He cites a case in which he employed this treatment with good results. The patient, a boy, aged ten and a half, who had been treated with arsenic and quinine without any benefit, improved greatly and finally was cured after the inhalation of oxygen, combined with arsenic internally. The boy had reached a condition of extreme weakness, being entirely confined to bed with a loss of appetite and tendency to vomiting; the spleen was considerably enlarged and the white and red corpuscles in the proportion of one to ninety. The treatment began in December, 1882, and after a daily inhalation of about thirty litres the boy could leave his bed in ten days and could go to school about the end of February. Some variations in his condition occurred from time to time, but about the middle of September the author considered him to be definitely cured. The number and proportion of the red blood corpuscles having returned to the normal. (Practitioner, May, 1884, from Deutsche Med. Woch., Oct. 10, 1883.)

CHLOROSIS.— Dr. Beddoes reported a number of cases of chlorosis cured by the use of oxygen.

Dr. C. D. F. Phillips has also had some good results from oxygen in this affection.

ASPHYXIA AND POISONING.—Loyssel published the result of his extensive experience with oxygen in the Journal de Medicine de Bruxelles, August, 1884, in which he formulates the following conclusions as to its use in cases of asphyxia and poisoning.

1.—In certain cases of poisoning, viz., by chloroform, ether, chloral, opium, sulphide of hydrogen, carbonic oxide and hydrocyanic acid, oxygen is the only means of preserving life after all other means have failed.

2.—Its presence in the operating-room would be an infallible safeguard against fatal accidents from the use of anæsthetics. It promptly restores sensibility, and eliminates narcosis in all such cases.

3.—It offers the best prospects for success in asphyxia from strangulation, drowning, poisonous gases, etc., as, also in cases of suspended vitality in the new-born.

4.—It will almost surely sustain life in all cases in which respiration has not entirely ceased even if the intervals between inspirations be very great, provided it be persistently exhibited.

5.—If cardiac and respiratory action have been absent for but a short time, resuscitation is often possible through the use of oxygen; and this agent should be perseveringly used in all such cases, even when appearances indicate that all efforts will prove useless. Cases have been frequently reported of drowned persons, and apparently still-born children being fairly raised from the dead by persistent endeavors with oxygen.

gas as a remedy against the deleterious effect of chloroform as an anæsthetic. (Cohen on Inhalation).

Phillips' work (Mat. Med. and Ther.) contains the following most striking case of asphyxia from sewer gas quoted from Dr. Chas. B. Ball:

A man, wife and daughter were found unconscious in a small room where there had been through the night a large fire, though the chimney was blocked. The two adults recovered with fresh air and ordinary means, but the daughter, aged sixteen (phthisical) remained unconscious and convulsed. After many hours of stimulating treatment she seemed to be dying; respiration was feeble and slow, the pulse imperceptible; then she was made to inhale pure oxygen, afterward oxygen and air. "The effects were rapid and marked": respiration, color, and pulse improved, and though at first convulsed, she ultimately recovered: Dr. Ball, impressed by this case, and remembering Regnault's proof that man can live in an atmosphere strong in carbonic acid, provided that the oxygen is also increased, has contrived an apparatus with a reservoir of oxygen and a mask for safe use in dangerous mines. He has himself respired an atmosphere containing 18 per cent carbonic acid with 30 per cent oxygen added. (British Med. Jour. i., 1878.)

At a meeting of the Societe de Therapeutique (Bul. Gen de Therapeutique, Feb. 15, 1880), M. Crequy reported that he had used with success in a case of poisoning by laudanum, inhalations of oxygen; and adds to this, one he observed three years ago: A woman asphyxiated with coal gas, was cured by the same treatment. But he adds that this treatment should be prolonged beyond the apparent cure, otherwise the patient would be exposed to the return of the toxic symptoms. (American Jour. of Med. Sciences, July, 1880.)

We have used it with success in asphyxia from pulmonary and cervical congestion, in another case where asphyxia was complicated with an apoplectic condition, oxygen was of still more signal service. (Trousseau's Therapeutics.)

M. Paul has been successful in a case (of poisoning with charcoal gas) in which the face was livid, the surface cold, the pulse very small, and the dyspnœa decided. In such a case the action of the gas is probably due chiefly to its superior displacing power for carbonic acid in comparison with common air.

Dr. Alonzo Clark reports two cases of asphyxia from illuminating gas, in the New York Medical Record, Aug. 11th, 1883.

A woman and her daughter had remained all night in a room in which gas was escaping; about noon the next day they were discovered and removed to Bellevue Hospital. Condition of mother was as follows: unconscious and cyanotic; pulmonary œdema; radial pulse, scarcely perceptible; extremities cold; trismus of the flexor muscles; urine passed involuntarily; pupils slightly contracted frothy mucous issuing from the mouth; temperature 95.5, respiration 40. Inhalations of oxygen were administered for three hours, and, in addition, dry cups to the chest, and whisky and digitalis subcutaneously. Patient made a good recovery.

Condition of daughter was much the same, though, in addition to symptoms observed in mother, she had clonic spasms involving the left side of body, and bird-claw contraction of both hands. She also made a good recovery under the use of oxygen.

The effect of opium in reducing the frequency of respiration indicates that the sensibility is so blunted that the blood requires to become unnaturally charged with carbon before the ***besoin de respirer*** will excite to the act of respiration. Hence the blueness of the face, and the generally asphyxiated appearance. We should suppose *a priori* that oxygen would be useful in such cases, and such has been found to be the fact. Beddoes cured a patient by its means, and M. C. Paul mentions a case in which the gas was used successfully after atropia had failed, and when the patient appeared to be dying. The respiration had fallen to 7, the pulse was very rapid and hardly perceptible, and there was mucous rattling in the throat. (Bul. Gén. de Thérap., tome lxxv.)

I have administered it in two cases, in which it acted favorably, but as atropia was also given, it is difficult to say how much the oxygen contributed to the result, although the immediate effect of the gas was unmistakably beneficial.

In a case of poisoning with chloral, occurring recently in the practice of Dr. Jerome C. Smith, of New York, oxygen was decidely favorable in effect in giving firmness and regularity to the pulse, and in relieving the determination of blood to the head. (Smith's Essay, Second Ed.)

Dr. Richardson insists on the importance of using oxygen inhalation in strychnia poisoning in conjunction with amyl nitrite, "as unless elimination be promoted by oxygen, the spasm, even if relieved, soon returns."

Auanoff has . . . proved that pure oxygen is distinctly antagonistic to strychnia-action, and that when supplied to animals poisoned by this alkaloid it relieves them more than free access of ordinary air or any movements. (Phillips' Mat. Med. and Thera.)

Spasmodic and Other Nervous Diseases.

PUERPERAL ECLAMPSIA.— Dr. Schmidt relates in the Russkaya Meditsina (Lancet, Sept. 19, 1885,) a case of puerperal convulsions successfully treated by inhalation of oxygen.

The patient who, in order to prevent the convulsions, had been kept constantly under the influence of chloroform, was unconscious, and in a state bordering on asphyxia; but after a few rather deep inspirations of oxygen she began to show signs of returning consciousness, and, after inhaling rather more than a cubic foot of the gas, consciousness was wholly restored.

No further convulsions occurred, and the patient made a gradual but complete recovery.

Dr. Farr, of Kharkov, at the suggestion of Prof. Lashkevitch, of St. Petersburg, reports in Vratch, No. 13, 1885, two cases of puerperal eclampsia in which oxygen inhalations were followed by brilliant results.

The first was that of a seamstress, aged nineteen, who was brought to the hospital in an unconscious state, cyanotic, with stertorous breathing, the convulsive paroxysms being very frequent, and each preceded by a uterine contraction. Warm baths, wet packings, and enemata had been thoroughly tried, without affording any relief. Chloral hydrate failed to mitigate the paroxysms, and even chloroform inhalations gave but slight and transient relief. Oxygen was then resorted to as a forlorn hope. Within five minutes from the first inhalation of the gas the patient recovered consciousness sufficiently to ask for a glass of water, the pulse fell from 120 to 90 per minute, and a tranquil sleep of two hours' duration intervened. At the end of this period uterine contraction recurred without exciting any eclamptic seizure; but on suspending the oxygen inhalation the paroxysms soon returned, A fresh supply of the remedy brought each paroxysm to a speedy termination, and quiet sleep followed each resumption of oxygen inhalation. At this juncture, the os being not yet dilated, Barns' dilators were used, the membranes punctured, and the delivery completed without further accident. The patient was discharged on the nineteenth day after confinement, in a very comfortable condition.

The second patient, a primipara, aged eighteen, had two paroxysms of eclampsia, *post-partum*, twenty minutes apart, and lasting twelve minutes each, the patient remaining unconscious in the interval. On the administration of oxygen, consciousness at once returned. Four more paroxysms followed, but were very much milder, and separated by intervals of entire consciousness and perfect comfort. This patient made a rapid and satisfactory recovery.

Dr. Farr concludes his paper by expressing his enthusiastic hope that further tests will so corroborate these results that, in the near future, oxygen gasometers will become a common and indispensable feature in all lying-in hospitals.

Reimann, in Centralbt. f. Gyn., December 5, 1885, summarizes five recently published cases of eclampsia in which the treatment by oxygen inhalations was adopted.

Two out of five died, while in one of those that recovered the oxygen was quite useless. In the other two cases of recovery the eclampsia set in during the post-partum period, and it is always in such that the prognosis is most favorable. Reimann thinks the evidence justifies the opinion that oxygen is no better than numerous other remedies that have been tried for this disease.

It seems, however, to have a somewhat beneficial influence on the coma and on the respiratory affections, and may therefore be used as a pallative. Reimann thinks that the most good may be expected from remedies which stimulate cutaneous activity, and has repeatedly seen good results from the cold pack.

URÆMIC CONVULSIONS.—Dr. Howard Pinkney reports the following case: I have used it in one case of uræmic convulsions, following scarlet fever, (a case of Dr. Markoe's) where the inhalation of eight (8) gallons of gas seemed to have checked the convulsions entirely, as they never returned, and the patient made a slow but perfect recovery.

TETANUS.— Richardson refers to some cases of tetanus, under Sir J. Paget much relieved by oxygen inhalation; the patients became bathed in perspiration, and the muscles relaxed. (Phillips.)

HYDROPHOBIA.— Drs. Paul and Josias used oxygen in this malady and, although the patients died, some relief was given to the symptoms of asphyxia. Recently Dr. Schmidt has recorded the case of a girl, aged twelve, who, when recovering from diphtheria was bitten by a mad dog; seventeen days afterward she had great difficulty of breathing and of swallowing, and oxygen inhalations relieved her; she relapsed next day with convulsions, spasms of the respiratory muscles, and unconsciousness; oxygen again relieved her, and, after some complications traceable to the diphtheria, she ultimately recoved. (Medical Record, 1878.) (Ibid.)

HYSTERIA.— Oxygen has been found, by Prof. Laschkewitch, to be of benefit in hysteric and hystero-epileptic attacks. He thinks that it lessens nervous excitability. (Medical Record, Feb. 13, 1886.)

Dr. Richardson asserts that "Oxygen is a remedy for all excess of nerve action leading to spasm."

EPILEPSY.—Mr. S., aged thirty-eight, married, barber. Had been complaining for about two years; during this time he had been under the care of several different physicians, none of whom had ventured to give a positive diagnosis. He dated his trouble from a "fainting fit" which he had about two years ago, while at work in his shop; he suddenly became unconscious without any premonition whatever. I could not learn anything very definite of this attack, he only knew that he was suddenly seized with a faint and fell to the floor unconscious. Consciousness was not fully regained for half or three-quarters of an hour, and then he "felt strange" and his mind seemed confused, for the remainder of the day. He did not think there were any convulsive movements during the seizure, though he was not certain. He was taken home in a carriage, vomiting upon the way, and once or twice after reaching the house. Had one or two returns of the "faint feeling" but did not entirely lose consciousness. It was almost a week before he recovered sufficiently to continue his work. The attacks have recurred at varying intervals, though never as severe as the first one. Sometimes, when feeling perfectly well and engaged at his work, he will become suddenly faint and be compelled to sit down for a few moments; occasionally there will be moments when he loses himself entirely, and will remain motionless with a fixed gaze for a few seconds, then recover as though nothing had happened. His wife informed me privately that he acted very odd at times, and she feared his mind was becoming affected, as he was subject to fits of despondency, and conceived the notion that he had consumption. This was strengthened by an annoying cough to which he was subject. He complained of pain in the right mammary region, sometimes extending downward to the liver; was also subject to rheumatic pains, which frequently changed their seat from one joint to another. In changeable or wet weather these pains often prevented him from working, Physical examination of the lungs failed to reveal anything abnormal, no evidence of cardiac trouble was discovered, valvular sounds being normal and no disturbance of rhythm. Examination of the throat revealed post-nasal catarrh—hypertrophic—and to this I attributed his cough. The urine was found heavily loaded with phosphates. Specific gravity 1030; no trace of sugar or other abnormal constituents. Appetite capricious, bowels fairly regular, sleep frequently disturbed by dreams.

He was given the modified gas, very small treatments at first, as a disagreeable dizziness was produced if much was taken; this, however, passed away gradually, and in two weeks he could take four gallons without the slightest discomfiture. Treatments were given daily for almost five weeks.

Without going further into detail, will say that the improvement from the first was prompt and decided, *all* the symptoms improving. He had but one or two of the "fainting spells" after commencing the treatment. The cough and pain in the chest gradually decreased and the rheumatism ceased to trouble him except slightly in changeable weather. In three weeks the urine had cleared up, and the specific gravity had fallen to 1025. It is now about six weeks since he stopped taking the oxygen; he continues to feel well and has had no return of the unconscious seizures.

Now, the question remains, what had we to deal with here? I am not prepared to give an unqualified answer, but will merely suggest that the symptoms point strongly to its being a case of "petit mal." If I am right in my surmise it still remains an open question as to what the final outcome will be. One thing is certain, however, and that is, the symptoms were promptly and satisfactorily allayed by the use of the oxygen treatment.

Six months later.—This patient has thus far had no repetition of the seizures.

" Beddoes claims to have cured one case, while in five other cases he was entirely unsuccessful.

" Birch adds to his almost miraculous cures two of epilepsy, one case being of thirty-years' standing.

" Dr. Ramskill (Medical Times and Gazette, July, 1863,) reports a case of epilepsy in a young man, aged twenty-three, resulting from syphilis. The attacks occurred every fourteen or fifteen days. He inhaled oxygen twice or three times a day, stopping the inhalation only when a feeling of dizziness came on. At the end of three months he had had only one attack, which was slight. The cachetic aspect which he previously had had disappeared. Two years after, he saw him in perfect health. He had had no attack for sixteen months."

Miss E. L. C—, sixteen years of age. For three years past subject to epileptic convulsions. Family history shows the malady to be hereditary. Patient tall, slender, with stooping awkward gait, languid attitude, flabby muscles, sallow complexion, feeble pulse, morbid appetite, and poor digestion. Complains of constant cephalalgia, and, in short, is decidedly chlorotic. Has never menstruated, and her mother associated her malady with this fact.

Aug. 13th.—Patient placed on—℞ oxygen, 1 volume; atmospheric air, two volumes; four gallons at each daily sitting. Inhales about 60 cubic inches at an inspiration.

Aug. 20.—Mother reports that she sleeps better and does not have her nightly "fit." Can inspire 90 cubic inches at an effort. Ordered Chalybeates and nutritious diet, for the latter of which she begins to show a natural desire.

Aug. 30.—Still no return of the paroxysms. Cephalalgia has disappeared; appetite, digestion and general health much improved. Lung capacity, 100 cubic inches.

Sept. 14.—Proportion of free oxygen increased to fifty per cent; five gallons each sitting every other day. Patient resumes her classes in school; walking several miles daily without fatigue. Inspires 150 cubic inches.

Oct. 10.—Slight convulsion, after severe exposure, attending an evening political demonstration. Daily treatment resumed; same formula as at last record. Lung capacity increased to 115 cubic inches.

Nov. 1st.—Improvement has been constant; appetite fairly insatiable; digestion excellent, and is one of the most boisterous of her class on the playground.

Nov. 10.—Treatment continued; catamenia appear, naturally and without disturbance.

Nov. 25.—Patient asserts herself "well." Treatment suspended. (Six months later, no return of convulsions, health excellent.) (Dr. Samuel S. Wallian, in Medical Record.)

Dr. Wallian also reports (Chicago Medical Journal, March 1, 1869,) a case of epilepsy cured by the use of a mixture of oxygen and nitrous oxide.

" NEURALGIA.—Dr. J. Hooper was entirely successful in a case of obstinate neuralgia which had resisted a great variety of treatment. (Brit. Med. Jour., March 15th, 1862.)

" La Passe (Essai sur la Conservation de la Vie) states that he cured himself of *atroces migraines* by frequent inhalations of oxygen.

" Hill cites one case, neuralgic pain in face, which had resisted every form of treatment, and which yielded promptly to oxygen.

" Demarquay.—Case of *migraine* complicated with neuralgic pains recurring in daily paroxysms, entirely cured by oxygen.

Birch.—Case of nervo-congestive headache, of long standing, perfectly cured; another case in a lawyer, from overwork of the brain, relieved while taking the first inhalation. A third, connected with uterine derangement, and occurring periodically, entirely cured.

" Dr. Mackey, Professor of Materia Medica and Therapeutics, Queen's College, Birmingham.—Three cases of headache, one from chlorosis, one from bilous attacks, and one from depression from over-use of brain and from mental anxiety—all permanently relieved, the headache ceasing each time *during the inhalation* of the gas.—(Practitioner, May, 1869.) These are three out of ten cases of various diseases relieved by oxygen. He considers that these ten cases had this in common, that there was venous congestion in some organ or other. Speaking of neuralgia in general, Demarquay says: 'The blood is the regulator of the nervous system. According to this idea, it would be right to endeavor to allay certain troubles of the nervous system by introducing into the blood a greater quantity of oxygen. In fact, modifying the conditions of the blood ought naturally to induce a change in the essential character (*maniere d'etre*) of the nervous system, central or peripheric."

"PARALYSIS.—Beddoes cites two cases cured, one relieved, and one not benefited.

"Birch describes a case of complete paraplegia, of 'several years' standing, entirely cured by two years' persistent use of oxygen.'

Dr. Wallian reports this case (Medical Record, Oct., 1885): S. A. C., merchant, aged fifty-nine. Case of chronic rheumatism, severe dyspepsia, and slowly progressive locomotor ataxia. Oxygen treatment undertaken by means of a portable rubber bag, patient being confined to his bed and completely helpless. Result of six weeks' treatment, gradual amelioration of all the symptoms. Locomotion became possible by the aid of a cane, and so remains at this writing.

INSOMNIA.—Mrs. S., aged forty-three; a case of insomnia with all the usual attendant nervous symptoms, had taken Hydrate of Chloral, Sulphate of Morphia, Bromide of Potassium, until such large doses were required to produce any effect whatever that her family became alarmed and determined, if possible, to find relief for her in some other way. The oxygen being the latest candidate for public favor in the medical field it was determined to give it a trial. Upon questioning the patient, I found that her trouble was induced by overwork, both mental and physical, the patient having, two months previous, undertaken to instruct a large class of ladies in a special line of study. The amount of work required, together with her anxiety lest the whole undertaking prove a failure, so completely over-taxed her that insomnia and nervous prostration was the result. She was put upon the modified mixture, commencing with two gallons daily. This was changed after a few days by increasing the proportion of nitrogen monoxide two volumes. For the first few days she felt but little effect from the treatment, but as soon as N^2O was increased she at once felt a decided benefit and secured a few hours of refreshing sleep. Two or three nights of even partial rest worked wonders. Her appetite increased, her usual strength began to return, and she continued her work with renewed vigor, in place of abandoning it, as she had about decided to do when she came to me. After ten days' treatment she slept about as well as ever. The treatment after the first week consisted of about 75 per cent of N^2O, and on a few occasions the pure N^2O was administered, just previous to retiring. The oxygen was continued for about five weeks though not very regularly toward the last as she felt but little need of it.

NEURASTHENIA.—Dr. K. J—, aged forty. Has been a chronic sufferer from indigestion and "neurasthenia." In one month the indigestion is a thing of the past. He eats the miscellaneous fare of a well-kept hotel with impunity. Has gained five pounds in weight, and says he feels rested and much stronger. Can hunt fish and climb mountains without great fatigue. Says he feels physically "renovated," and returns to his practice with zest.

S. C. H——, aged thirty-seven; married; suffering from distressing dyspepsia, insomnia, and decline of virile power. After four weeks of active, but somewhat interrupted treatment, he declares himself a "new man." Was able to sleep soundly all night, for the first time in two months, after a single treatment — six inspirations. Now sleeps, eats, and digests well, and asserts that his virile powers are all that he could desire! In respect to this latter result, it was a surprise to me, but I have since noted the same revival in a very marked manner in a number of additional cases. The treatment has proved a prompt restorative to this function ***in every case since observed,*** in which loss of sexual appetite and power, ***in either sex,*** had been a marked feature. (Dr. Wallian, in Medical Record.)

Female Disorders.

PELVIC CELLULITIS.—Dr. Wallian reports a very interesting case, which is too long to be given in detail, but the principal points are as follows:

Mrs. L. F. L., aged forty-seven. The commencement of trouble dated back twelve years, to a miscarriage, from which she made a poor recovery; pelvic cellulitis followed, eventuating in chronic abscess, which found exit through a tortuous sinus and reached the surface in the right labia majora. Incision and careful treatment proved unavailing, it refilled and caused her much trouble.

"During the past three years patient has suffered from lumbo-sacral neuralgia and wandering arthritic pains. Six months since, her neuralgia culminated in a painful and disabling sciatica of the left side." "I found her anæmic, suffering paroxysms of excruciating pain, which extended from the hip to the ankle; bowels constipated and moved only by enemas; dysuria a frequent symptom; appetite wanting, and much gastric distress."

"Various tonics and anodynes were thoroughly tried, which only aggravated her stomach trouble and induced intense cephalalgia and distressing nausea. She also suffered from periodic rheumatic headaches.

"February 1st.—Prepared a mixture of O two volumes, N_2O two volumes, and diluted this with twenty per cent of common air. Of this, two full inspirations to be taken at 10 A. M., and the same on retiring. Lung capacity 100 cubic inches. The first few doses of the mixture produced such complete muscular relaxation and semi-insensibility that she sank to the floor unless supported; no unpleasant sensations or effects supervening."

By the middle of March, had gained in flesh, and a troublesome "salt rheum" which had persisted for thirty years was gone. Paroxysms of headache were rare and light. Lung capacity increased to 150 cubic inches. Abscess entirely healed; sciatica still persisting, but mild.

Treatment continued, changing the proportions by adding twenty per cent of common air, and increasing to four full inspirations at a sitting, twice per diem.

Steady improvement continued during April, and on May 18th, treatment discontinued, patient asserting that she was "well."

"September 15th.—Continues to this date free from all former complications."

FATTY PLACENTA.—"Assuming the correctness of the views upon which Prof. Simpson bases the treatment of such cases with chlorate of potash, we should have in oxygen a more direct and powerful remedy than any heretofore employed. Once prove that the fœtus perishes from a deficient supply of oxygen through the maternal blood, consequent upon diseased placenta, and the indication is as plain as in croup or asthma.

I have recently received a letter from Messrs. George Barth & Co., of London, engaged in supplying oxygen for medicinal purposes, from which the following is an extract: "We know of a case of defective placenta and consequent repeated abortions where the daily inhalation of oxygen — 4 pints to 24 of air — for three or four months was attended by the best results; the patient was subsequently delivered of a healthy child." (Smith's Essay, Second Ed.)

IRREGULARITIES OF MENSTRUATION.—Beddoes and Birch both cite cases in which irregularities of the menstrual functions were corrected by the use of oxygen. The first case described by Birch is one in which the return of each menstrual period was attended by a most excrutiating headache, beginning two days before the period, and continuing two days after its cessation. During all this time the patient was obliged to remain in bed, in a darkened room. This state of things had continued for a number of years, and had resisted every possible form of treatment. The use of oxygen for a short time produced a perfect cure.

In another case, along with various uterine symptoms, there was fullness and weight about the neck and about the base of the brain, and impairment of all the special senses, and also partial paralysis of one side of the tongue. The patient was at the menopause. A few inhalations of oxygen produced a great improvement in the sight and hearing, and a course of six weeks completed the cure." (Smith, on Oxygen in Disease.)

VOMITING IN PREGNANCY.—In some obstinate cases, Dr. Pinard, tried. with immediate relief, inhalations of oxygen, lead thereto by the fact that the vomiting of chlorotic subjects is often relieved by this means. (Atkinson's Therapeutics of Gynæcology and Obstetrics.)

May 16, I was called to see Mrs. H., who was in the second month of pregnancy. For two or three days she had so much nausea and vomiting that she could retain no food upon her stomach. During the next three weeks I gave her most of the homœopathic remedies that are recommended for this obstinate trouble, as well as oxalate of cerium, apomorphia, fl. ex. coca, cocaine, pounded ice, Faradic current, mustard plasters, etc., but all to no effect. When the three weeks were past she had not retained a mouthful of food, nor any of the nutrient enemata that I had given her. She was growing so weak that I was contemplating provoking abortion, when one evening I carried her a mixture of oxygen and nitrous oxide gases in a rubber bag. When I entered the room she had just been vomiting some cold water, which she had taken in her thirst. After taking one good inhalation of the gas she exclaimed, "Doctor, that seems to dissolve the lump in my throat." It is now nearly two weeks since she began taking the oxygen, and she has inhaled it regularly every day. *She has not vomited once since the first inhalation.* Her strength and appetite have rapidly improved, and she is now getting along nicely. (F. A. Churchill, M.D., Seattle, Washington Ter., in Medical Current.)

Dr. Klikowitsch has found the use of the mixed gases (80 per cent N_2O and 20 per cent O,) of value in vomiting of reflex origin.

Surgical Diseases.

CHRONIC PYÆMIA.— My notes present a case of this disease in which oxygen was apparently the means of rescuing the patient from otherwise inevitable death. W., aged fifty years, had been operated upon four weeks previously for stricture of the urethra, by external division. A few days after the operation chills set in, and soon an abscess formed under the pectoral muscles of the right side. Another abscess soon followed on the left arm, and a third over the sacrum. By this time his strength was reduced to the lowest ebb. He was unable to raise his head from the pillow, his pulse was 112, soft and gaseous, countenance Hippocratic; vomited every thing taken into the stomach. Tongue broad, dry, leathery, deeply fissured, of a light brown color. When I first saw him his friends had already given the necessary directions for forwarding his remains into the country, and a clergyman had administered the last consolations of religion. Within the preceding twenty-four hours a circumscribed pleuropneumonia had developed in the right lung. His case, sufficiently desperate before, seemed now perfectly hopeless. Nevertheless, with the consent of the attending physician, I determined to see what could be done by oxygen. About four gallons were administered every two hours, beginning at 11 A. M. Each time the gas was given the color returned to the cheeks and lips, and the patient expressed himself as feeling "brighter." The pulse remained about as frequent, but seemed to gain a little strength. Before night the tongue had become moist at the tip and edges, there was less irritability of the stomach, and the pain in the chest had greatly abated. The gas was given every three hours during the night and the following day. The close of this day found the patient with a tongue moist throughout, pulse 108, no vomiting, no pain, to speak of, in the chest; was able to take freely of stimulants and beef-essence. From this time he gradually but steadily improved. The pleuro-pneumonia disappeared, without running through the usual stages. The appetite returned to a moderate degree. Two more chills occurred, but no further abscesses. The gas was continued about three weeks, the doses being less frequent as the patient improved. At the end of that time convalescence appeared to be established, and the oxygen was discontinued.

Whether in this case the gas exerted any influence upon the septic material in the blood, or whether its effect was merely stimulant and tonic, it is difficult to determine. It is certain, however, that a very remarkable improvement took place simultaneously with the administration of the gas, and which could be attributed to no other agency.

The prolonged contact of oxygen with a denuded surface produces a stimulating effect which varies in degree with the condition of the surface. In the case of recent wounds there is merely a sensation of warmth. In suppurating surfaces the first effect is to render the granulations less florid and softer, and to increase the discharge. If the contact be too prolonged, however, or too frequently repeated, there will be a subsequent reaction so decided as to compel a suspension of the treatment. An analysis of the gas after prolonged contact with a denuded surface shows the presence of an abundance of carbonic acid and a considerable loss of oxygen. (Demarquay.)

SEPTICÆMIA.—Septicæmia after parturition, caused by retention and putrefaction of clots. Ergot was given, and whether from that cause or from absorption of putrescent matter, gangrene of the feet was threatened. The pain in the feet was agonizing; the toes became blue and almost insensible, "and the line of demarcation began to be foreshadowed." The pulse, which had almost ceased in the extremities, was found to be 180 in the carotids. The body was covered with a cold, clammy sweat. The ergot was stopped, and quinine (gr. x bis die,) beef-tea and wine given, together with injections of carbolic acid and hot applications to the feet. The next day inhalations of oxygen were begun, and the following day reaction set in, and convalescence was gradually established. How much was due in this case to the oxygen, how much to the other treatment, and how much to the powers of nature, it is impossible to determine. (Dr. G. Frauenstein.)

ULCERS.—Beddoes, even in the infancy of the use of oxygen, observed its effects upon obstinate and ill-conditoned ulcers. Among others, he quotes a few cases o scrofulous ulcers of the arms and of one leg, healed in a few weeks under the influence of "vital air."

Another case of ulcer of the leg, which had continued for eighteen years, and had been treated in vain for years by Pott, and for seventeen months by Sharp, healed at the end of four weeks under the influence of oxygen. Six months after, there had been no return of the ulcer.

A third case is related of an old scrofulous ulcer on the arm of a debilitated patient. The inhalation of oxygen, in gradually increasing doses, caused an astonishing effect upon the general health, but no tendency to cicatrization of the ulcer. On the contrary, after a time, an inflammatory action was set up. To counteract this, a certain amount of carbonic acid was added, and the inflammation was promptly subdued, and cicatrization took place.

Finally, in a fourth case, there was an ulcer on the leg four inches long and three inches broad, ill-conditioned, and of such a depth as to involve the muscles. After a year of treatment with a vast number of topical applications, together with tonics given internally, there was no improvement whatever. Oxygen was then resorted to, and a very rapid change took place. The general health, which was very much depressed, improved, the strength returned, the ulcer assumed a more favorable aspect, healthy pus was formed, and, in fifteen days the sore had closed over three-fourths of its extent. In six weeks from the commencement of inhalations cicatrization was complete. (Considerations on Factitious Airs, p. 65.)

INDEX.

Accessory treatment 39
Acids.
  Anhydrous chromic 5
  Carbonic 17, 19, 20, 45, 48, 128
  Hydrocyanic 125
  Nitrous 24
  Sulphuric 5, 25
  Uric 21, 40
Acid vapors 60
Administration 33
Albuminuria 115
Ammonia 24
Ammonium muriate 30
Ammonium nitrate 23
  Decomposition of 24
  Different forms of 23
  Elimination of foreign matter from 25
  Manner of applying heat to 25
  Point of fusibility of 24
  Tendency of, to deliquesce 24
  Tests for purity of 24
Anæmia 121
Aneurism 52
Angina pectoris 51
Apparatus 54
Aortic aneurism 52
Approximate scale 58
Asphyxia 16, 121, 125
Asthma 37, 52, 67
Bacteria 17
Barium chloride 24
Baryta 5
Bathing 39
Bichromate of potash 5
Boussingault's process preparing oxygen 5

Bromide of potassium 139
Bright's disease 116
Bronchitis 52, 72, 75, 117
Calcium chloride 5
Carbonate of calcium 8
Carbonic disulphide 45
Carbonic oxide 37, 125
Caustic Potash 24, 25
Caustic soda 10
Cellulitis, pelvic 141
Charcoal 9, 45
Charcoal gas 128
Chloral hydrate 37, 129, 131
Chlorate of potash 7, 29, 30
Chlorine 11, 24, 25
Chloroform 37, 45, 126
Chlorosis 124
Cholera 121
Cloth-lined tubing 10
Coal-gas 37, 127
Cobalt 5
Combustion 2
Commingling of gases 32
Compound oxygen 28
Compressed air 33
Compressed oxygen and nitrogen monoxide 64
Compressing pump 62
Copperas (Ferrous sulphate) 25
Croup 37, 77
Crystalline deposit 11
Cupric oxide 7
Cuprous chloride 5
Cylinders, heat condensing 61
Cylinders, portable, oxygen and nitrogen monoxide 65
Delirium tremens 52
Deville's process of preparing oxygen 5
Diabetes 41, 116
Diphtheria 37, 80
Dyspepsia 110, 118
Eclampsia puerperal 37, 130
Emphysema, pulmonary 83
Epilepsy 133
Epileptic convulsions 37
Erysipelas 51
Ether 37, 44, 45, 126
Ethylene 2

Explosion of retort 60
Ferric oxide 7
Ferrous sulphate 25
Flask 59, 61
Fleitman's process of making oxygen 5
Frame work for gasometer 57
Fresenius' process preparing oxygen 9
Gasometer 55, 56
Gas stove 61
Gelsemium 37
Gout 40, 119
Gravel 40
Hæmoptysis 37
Headache 52, 112
Home treatment, oxygen 6, 28, 30
Hydrate of chloral 37, 129, 131
Hydrogen dioxide (peroxide) 5, 116
" sulphide 125
Hydrophobia 133
Hysteria 52, 138
Illuminating gas, poisoning by 128
Indigestion 112
Infantile convulsions 37
Inhaling bottles 63
Insomnia 52, 119, 139
Laudanum 127
Laughing gas 44, 45
Leukæmia 124
Mallet's process preparing oxygen 5
Manganese dioxide (black or peroxide) 5, 8
Measles 51
Melancholia 52
Menstruation 143
Mercuric oxide 5, 7
Migraine 138
Morphia sulphate 139
Mouth pieces 57, 63
Neuralgia 138
Nervous exhaustion 52
Neurasthenia 52, 190
Nitrate of ammonia 23, 24
Nitrate of lead 30
" " silver 24
Nitric oxide 24
Nitrogen 17, 20, 24
Nitrous acid 24

- Nitrous oxide 23, 44, 46, 47
- Nitrogen monoxide (nitrous oxide, laughing gas) 23, 44, 46, 47
  - Action of 47
  - Anæsthetic properties of 45
  - Boiling point of 45
  - Compressed 64, 66
  - Colton on 47
  - Fumes formed during generation of 26
  - Freezing point of 45
  - Liquefaction of, by pressure 45
  - Methods of purifying 24
  - " " preparing 23
  - Properties of 54
  - Solubility of 27
  - Specific gravity of 62
  - Temperature, effect of, on 27
  - Temperature required to generate 26
  - " produced by evaporation of 45
  - Use of, combined with oxygen 44
  - Various authorities on 49, 50
  - Wallian Dr. on 46
- Opium 129
- Oxidation 3
- Oxygen.
  - Absorption of, by the blood 16
  - Affinity of, for metals 2, 24
  - Atomic weight 1
  - Cabinet 63
  - Compressed 64
  - Combined with nitrogen monoxide 44, 50
  - Compound 28
  - Caution in use of 35
  - Conditions influencing absorption 16, 17
  - Discovery of 1
  - Distribution of 1
  - Effect of, on bodily temperature 21
  - Forms of 1
  - Home treatment 6, 28
  - Influence of, on digestion 22
  - Influence of, on amount of urea excreted 20
  - Liquefaction of 2
  - Magnetism of 2
  - Methods of preparing 4
  - Portable apparatus 12, 49
  - Preparation of, from chlorate of potash 7
  - Properties of 1

Oxygen.—Continued.
- Proportion of, in air 1
- Proportion of, in water 8
- Proportion of, in solid earth 3
- Proportion of, in animal world 4
- Proportion of, in vegetable kingdom 4
- Power to re-excite ventricular contraction 19
- Quantity of, in the blood 17
- Quantity of, consumed 17
- Quantity of, consumed by animals 3
- Quantity of, consumed in natural world 3
- Relation of amount consumed to carbonic acid formed 19
- Solubility of 2
- Specific gravity of 1
- Symbol of 1
- Standard proportion of 32
- Theories of, Priestley, Lavoisier and Smith 15
- Use of, in disease.
  - Albuminuria 115
  - Anæmia 121
  - Angina pectoris 51
  - Aortic aneurism 52
  - Asphyxia 16, 121, 125
  - Asthma 37, 52, 67
  - Cellulitis, pelvic 141
  - Cholera 121
  - Consumption 35, 37, 52, 88
  - Croup 37, 77
  - Delirium tremens 52
  - Diabetes 41, 116
  - Diphtheria 37, 80
  - Dyspepsia 110, 118
  - Eclampsia, peurperal 37, 130
  - Emphysema, pulmonary 83
  - Epilepsy 37, 130
  - Gout 119
  - Hæmoptysis 87
  - Headache 52, 112
  - Hydrophobia 133
  - Hysteria 52, 133
  - Infantile convulsions 37
  - Insomnia 52, 119, 139
  - Lenkæmia 124
  - Measles 151
  - Melancholia 52
  - Menstruation, irregularities of 143

Oxygen. use of, in disease.—Continued.
Migraine 138
Neuralgia 13
Neurasthenia 52, 140
Nervous exhaustion 52
Obstructed respiration 37
Paralysis 139
Petit mal 136
Placenta, fatty 143
Pleuro-pneumonia 147
Pneumonia 85, 116
Phthisis 35, 37, 52, 88
Poisoning by charcoal gas 128
Poisoning by chloroform 126
Poisoning by coal gas 127
Poisoning by sewer gas 127
Poisoning by strychnia 130
Pseudo-leukæmia 124
Pregnancy, vomiting of 144
Rheumatism 119
Salt rheum 142
Sexual appetite, loss of 141
Septicæmia 148
Spermatorrhœa 118
Spinal irritation 52
Suspended animation 37
Tetanus 133
Typhoid Fever 51
Uræmic convulsions 132
Ulcers 148
Virile power, decline of 141
Opium 129
Ozone 3
Paralysis 139
Pelvic cellulitis 141
Peroxide of hydrogen 5, 116
Peroxide of manganese 5, 8
Petit mal 136
Piping for conducting gas 58
Phthisis 35, 37, 52, 88
Platform for gasometers 57
Placenta, fatty 143
Pleuro-pneumonia 147
Pneumonia 85, 116
Poisoning, use of oxygen in 16, 37, 45, 121, 125, 126, 127, 128, 129, 130
Portable apparatus 12, 49

Portable oxygen cylinders 65
Potassium chlorate 7, 29, 30
Pseudo-leukæmia 124
Priestley 1, 5, 15
Pregnancy, vomiting of 144
Pulmonary emphysema 83
Pyæmia 145
Respiration obstructed 37
Retort 59, 60, 61
Rheumatism 119
Rubber corks 59
Rubber tubing 60
Salt rheum 142
Sexual appetite, loss of 141
Septicæmia 148
Soda caustic 10
Spermatorrhœa 118
Spinal irritation 52
Stop cocks 56
Steam gauge 62
Strychnia 130
Sulphuric acid 5, 25
Sulphide of antimony 9
Sulphide of hydrogen 125
Sulphate of zinc 5
Suspended animation 37
Tetanus 133
Tubing, rubber 60
Typhoid fever 51
Ulcers 148
Uræmic convulsions 132
Urea 20
Uric acid 21, 40
Virile power, decline of 141
Zinc sulphate 5

LANE MEDICAL LIBRARY

To avoid fine, this book should be returned on or before the date last stamped below.

JAN 4 1966
MAY 6 1966
OCT - 7 1968
JAN - 6 1969
OCT 26 1970

U666 Ehinger, C.E.
O8E3 Oxygen in therapeutics.
1887 ~~12441~~

NAME	DATE DUE
N. Green	JAN 4 1966
FUKEDI	MAY 6 1966
Pat. Broach II	OCT - 8 1968
Albert Dani	JAN - 6 1969
Nikaido	OCT 2